THE ARTIZAN.

A Monthly Journal

OF

THE OPERATIVE ARTS.

VOL. XIII.

LONDON:
OFFICE OF "THE ARTIZAN" JOURNAL, 3, AGAR STREET, STRAND.

1855.

LONDON:
KELLY AND CO., PRINTERS, OLD BOSWELL COURT,
TEMPLE BAR.

INDEX TO VOL. XIII.

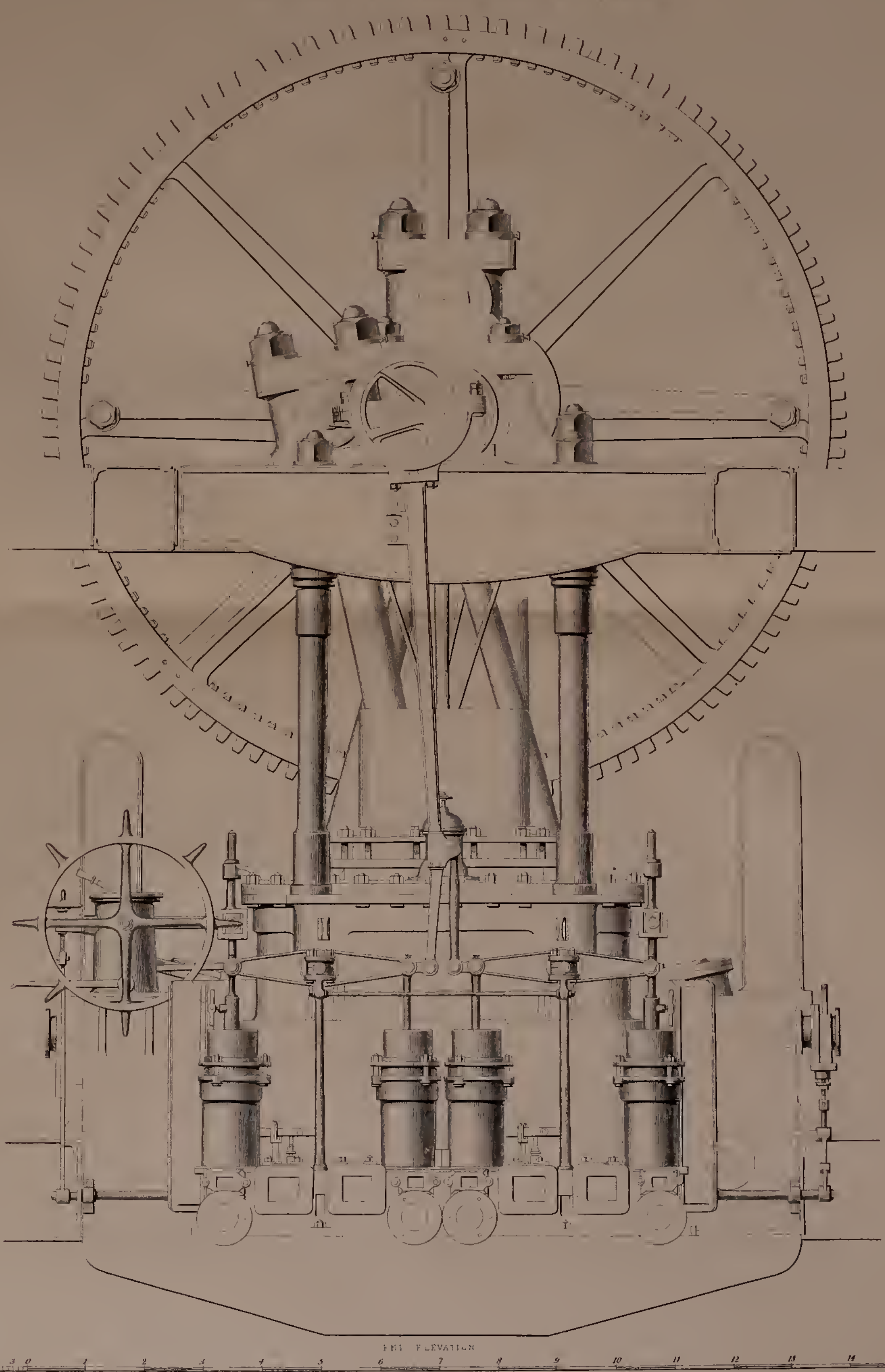
THE ARTIZAN JOURNAL, 1855.

A.

B.

C.

LIST OF PLATES.



END ELEVATION

THE ARTIZAN.

No. CXLIV.—Vol. XIII.—JANUARY 1st, 1855.

ENGINEERING EXPEDIENTS IN WARFARE.

Every engineer must feel that in the war which we are at present waging with Russia, the country has not yet been suffered to put forth its strength, and that many resources of the greatest power and efficacy have been rendered unavailing by the antiquated stiffness of our military system, and by the slowness and stupidity of Government boards and officials, by whom all useful suggestions are systematically discouraged until forced into adoption by the compelling influences of public opinion. In this war, as in former wars, we can count on the courage of our soldiers and the public spirit of the nation. We have also larger wealth than other nations, and these aids to success we are not unwilling to employ. But there is one element of success which we possess in perhaps a still more eminent degree—a large array of engineering talent; and it is only necessary that this talent should be exercised upon the tasks imposed by war, instead of being restricted to the tasks of peace, to accomplish the most eminent benefits. War is substantially an engineering operation. Our military engineers, however—and, indeed, *all* military engineers—are behind the age, and instead of narrowing our achievements to their capacities, we should throw the door open wide to all those who can accomplish tasks beyond the powers of stiff and orthodox practitioners. In all arts, useful improvement has usually been the work of interlopers; and if our military authorities would only arrive at a distinct conception of what they want to do, we have no doubt whatever that however hopeless the task might seem to them, it would not long remain unaccomplished. In this country we have an immense fund of ingenuity, and of mechanical and engineering knowledge, which only need a problem to be plainly laid before them to insure a speedy solution; and we do not know of any more advantageous step that could be taken than to send thirty or forty of our most skilful and inventive engineers to the Black Sea and Baltic, to contrive and execute achievements beyond the capacity of ordinary naval and military men. It is upon this fund of talent that we must in the long-run fall back; and why should it not be upon the spot, to adapt its expedients to the visible wants of the case, and also to save the ruinous delays which must else take place? Unless some expedient of this kind be adopted, all the ordinary machinery of warfare must be swept away, and we shall have wars, like railways, undertaken by contract. We should then be at least sure not only that every possible energy was used in urging on work, but that all expedients were availed of which appeared conducive to insure a speedy and successful result.

Cases are continually occurring during the progress of the war in which it is clear to us—and, no doubt, to others—that a moderate amount of engineering skill would have sufficed to accomplish results of great importance. For instance, when the Russian vessels were sunk in front of Sebastopol, a competent engineer ought to have opened a passage through them next day; and, as an illustration of the accuracy of the doctrine we have been seeking to propound, we shall explain in what way this operation might have been accomplished.

First and foremost, we would have caused the boats with muffled oars which sounded at night around the wrecks, to drop small kedge-anchors on and beside the wrecks; and these kedge-anchors would each be provided with a pulley, through which a line was rove. This being done, we would have attached to each line one or more hogsheads of gunpowder, previously weighted, so as to be brought to about the same specific gravity as the water, and well pitched, so as to be water-tight. The powder would ignite, either by a long burning fuse, or the electric wire. If the boats were not suffered from any cause to deposit the anchors, they could be shot out of a mortar, in the same way as is done in Captain Manby's apparatus to save life in cases of shipwreck; or a ship filled with sand might be taken in on each side of a boat despatched to operate upon the wrecks—precaution being, of course, taken so that these ships would not sink even though perforated with shot. A passage being, by means of gunpowder, pretty well cleared, a strong iron ship should be sent in at full speed, that would cut down any impediments that might remain. It would not be impossible, we may add, to lift or drag the vessels out of their position without any blowing up at all; and it appears quite certain that the vessels need not have been suffered to remain a single day in their position, if there had been competent engineers upon the spot to take the measures necessary for their immediate removal.

It may, perhaps, be considered as some recognition of the accuracy of these views, that the Government has lately engaged Messrs. Peto, Brassey, and Betts to construct a railway from Balaklava to Sebastopol. In the construction of cylinders to hold powder to blow up the wrecks, the Government has also availed itself of the talents of Mr. Armstrong, of Newcastle. These are steps in the right direction, and have given much satisfaction to the public. Mr. Armstrong, to whom we wrote for such information about these cylinders as he thought it right to give, has sent us the following letter:—

To the Editor of The Artizan.

Sir,—I have had many applications for particulars respecting the blasting-cylinders I have lately prepared for operating against the sunken ships at Sebastopol, but I have in all cases replied that I did not feel authorised to afford information on the subject. The paragraphs which have appeared in many of the journals have been very absurd, but the one which I enclose (taken from the "Newcastle Chronicle," Nov. 3), though not circumstantial, is at all events correct as far as it goes. I may tell you, further, that the voltaic apparatus to be used for igniting the magazines was rigorously tested at Woolwich Arsenal, when the conducting-wires were laid at the bottom of the canal and in the Thames, and numerous small charges of gunpowder were fired simultaneously under water. In every case, the explosions took place precisely at the same instant. Besides the large cylinders containing 1 ton of gunpowder each, there were a number of smaller ones containing about $1\frac{1}{2}$ cwt. each. One of these was exploded at the bottom of the Thames, and threw up an enormous column of water.

If you think it worth while to concoct a paragraph from this information, you are at liberty to do so; but I am sorry I cannot, at present, give you the particulars of the internal construction of the magazines, or the intended mode of using them.

I am, Sir, your obedient servant,

W. G. Armstrong.

Elswick Engine Works, Newcastle-upon-Tyne, 7th Dec., 1854.

"Armstrong's Cylinders for Blowing up Ships.—During the last ten days experiments have been in progress in the grounds of Mr. W. G. Armstrong, at Jesmond, near this town, to determine the most effectual mode of igniting, by voltaic electricity, the submarine powder-magazines which he has been directed to prepare for the purpose of removing the obstructions placed by the Russians at the entrance of the port of Sebastopol. The apparatus employed in these experiments has been arranged to explode a number of the magazines at the same instant through very long wires, which will lie at the bottom of the water, and we understand its efficiency for this purpose has been clearly ascertained. The magazines, which consist externally of wrought-iron cylinders about twelve feet long and four feet diameter, were forwarded to Woolwich from the Elswick Engine Works on Wednesday last. We are informed they are each to contain one ton of gunpowder."

Mr. George Mills, of Glasgow, to whom we have written in similar terms respecting his plan of floating-batteries, informs us that the plan is under consideration of the Admiralty, and that, consequently, he is not yet able to furnish information. The Admiralty is usually intolerant of new plans, and thinks it has accomplished its duties if it succeeds in wearing out and disgusting inventors. But this policy will no longer do. The nation has interests at stake too weighty to rest satisfied with official trifling and inaction, and instead of ingenious men being repelled by coldness or neglect, their co-operation should be invited, and, if found useful, rewarded. What will the Emperor of Russia do in such a case? Will he suffer ingenious men to languish who are willing to place their talents at his service in working out his designs? And shall we be less reasonable than our barbarian enemy? No doubt, every public department concerned in carrying out the war will be inundated with absurd plans and suggestions; but the plain remedy is to have a sufficient staff to examine the miscellaneous assortment, and while rejecting the bad, to make the most possible of the new and promising. Such departments should even go further, and say what things they are desirous of having accomplished; and we may be quite sure, if this be done, that they will not remain long unachieved.

PRACTICAL PAPERS.—No. I.

ON DESIGNING MARINE WORK.

We propose, in this paper, to describe the method employed by many engineers, in arranging the engines and boilers of a steamer, and instructing the shipbuilder as to the requirements of the engine and boiler room. This involves the description of three drawings, which we shall term the ship-drawing, the shafting-drawing, and the pipe-drawing. The second is an extension of the first. The three might be combined in one, it is true; but this would lead to confusion, first, because the drawings are necessarily made to a small scale if large vessels are in hand, and, secondly, because the shipbuilder does not require a pipe-plan at all. All that he has to do is to provide for the reception of the engine, boilers and shafting, and to allow openings in the decks for their first entrance and subsequent removal in case of repairs. The ship-drawing is made to show the height and position of engine-bearers, or kelsons, as they are commonly called; the height and position of boiler-kelsons; the abutments for entablature, or top frame of engine, which we shall term the deck-beams; the position of deck-beams *proper*, in case the engine be of such form as to require no support about the framing—as, for instance, horizontal, angled engines, &c.; the engine hatchways and boiler hatchways; the hand-holes in the kelsons, or "ways" in them for getting at the holding-down bolts; the beams for the wheels, if gearing be employed; the clearance in the boiler-kelsons, to allow of the blow-off pipes and cocks being placed under the firing-floor; the relative position of boiler and engines; the quantity of coal that can be carried in the bunkers between the engine-room bulkheads. Such a disquisition treats of that part of the ship which is contained between the bulkheads of the engine-room, this being determined upon by due attention to length of engines, firing-space, and boilers. The Editor of the "Examiner," writing an article on the loss of the *Arctic*, a few weeks ago, wound up with the inquiry, "Will no enterprising speculator start some *slow* ships for sure voyages?" As we do not think this question will soon be answered affirmatively, we shall consider the case of a swift ship; and as to realise a high speed in a screw-steamer rising floors are usually employed, we must take a form of engine that is contracted at the base, to avoid throwing the centre of the shaft too high in the vessel.

To determine the height of the engine-kelsons, and taking for example a pair of geared oscillators, such as the *Great Britain's* (the drawing of which will be found in the Number for February, 1852, of this Journal), the shipbuilder sends the midship-section, or section nearest the supposed centre of engines. On this the drawing of the engine must be tried. We take the case of geared oscillators in preference to any direct-acting form of engine, because the ship-drawing for such includes all that is necessary for the latter kind, and more, inasmuch as the supports for the entablatures must be shown on it. Our own opinion is most decidedly against the indirect class; and one more argument against them is the extra expense of engine-kelsons and beams, as many a shipbuilder has found to his cost. For a full-powered screw-steamer with a great rise of floor, the oscillator as usually arranged, with two air-pumps worked direct from the crank-shaft, requires a spread of condenser sometimes unsuitable to such a section. An eligible candidate to fill the engine-seat in a fine-lined vessel, is the vertical trunk-engine, with single casings on and between the cylinders, and two exhaust-pipes from each taken *outside* the air-pumps. The condenser can be made much narrower for this form of engine, because, from the absence of the exhaust trunnion-pipes, the centre lines of the air-pumps can be made to form a much more acute angle than in the oscillator; the extra length between the centres of the cylinders, supposing that the trunk-engine approximates to the form of an oscillator at rest, to allow the steam slide casings to be introduced, being compensated for by the absence of the steam trunnion-pipes of the oscillator.

However, to proceed with the fixing of the position of the geared oscillator, we must get it as low as possible, say three inches from the skin of the vessel; or, if the angle-iron frames come under the condenser, which we suppose to be the lowest part, then three inches from the angle-iron in the clear must be allowed. This will insure the engineer against inaccurate workmanship of the shipbuilder's men. The centre of the shaft being marked off, and figured from the upper line of keel, by taking from this the distance of bed-plate flange from crank-shaft centre we have the height of engine-kelsons, which are usually run up to the side of bunkers across the ship. To facilitate the erection of the engines in the ship, it is better not to carry the side-plates of the kelson up to this height, but to make them thus (Fig. 1), letting hard wood project from

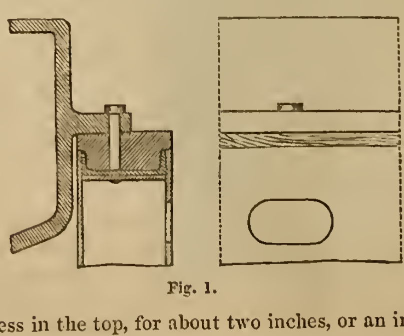


Fig. 1.

Fig. 2.

the recess in the top, for about two inches, or an inch and a half, and to tap the holding-down bolts into the metal. In fixing large engines, perhaps the best practice is to put bolts up through hand-holes in the kelson, and screw the bed-plate down with nuts. In this case, the hand-holes must be clearly shown in the kelsons, as they can easily be punched out of the plates before they are fixed in their places: the hand-holes should be about ten inches long by six inches deep, and rounded at the corners (as shown in the sketch), and at distances, suitable to the position of the holes for holding-down bolts in the bed-plate flange. Three-quarters of an inch is sufficient to allow between the inside of kelson and outside of condenser, and from four to eight inches bearing on the kelson is enough for the bed-plate flange. The holding-down bolts having their holes cast about one diameter from the extreme edge of flange—a little larger than the bolt, to avoid chipping and filing—the bolt, by being kept near the edge of the flange, is thrown more into the centre of the kelson. We suppose the engine to be level, but will show, presently, the method of giving the heights of the kelsons when the size of screw, as to its diameter, is such that the shafting must be considerably angled to suit it. The position of engine-kelsons, of course, depends upon the shape of bed-plate; but it may be remarked that the longitudinal kelsons ought to be stiffer than the transverse. The geared oscillator, as made for the *Great Britain*, should have two main-kelsons longitudinally—box-kelsons, thrown out to let the condenser in. For the cross-kelsons, a single plate and stiff angle-iron, mounted with hard wood and rivetted by angle-irons to the main kelsons (Fig. 2), is quite sufficient. They serve to tie the longitudinal ones together, and are fully able to bear the strain upon them. If the main-kelsons were not very stiff, the strain of the ship in heavy weather, or if run aground, would come on the cast-iron bed-plate flange, and break or spring the trunnion-pipes, in cross seas causing the engines to leak air. The beams for the wheels are fastened against the bulkhead, and are box-shaped, with the necessary hand-holes to let the pedestal bolts be handed up (shown in the drawing). The abutments for the engine-frame can usually be incorporated with the beams expressly for carrying the decks. If this cannot be managed, a couple of box-beams must be put longitudinally, stayed by angle-irons from the sides of the ship, and two more main (box) beams transversely. Some put long bolts through these beams, as an extra tie. The entablature is steadied by hard-wood wedges let in between its sides and the beam, but not strained by them. If bolts are put in, care must be taken that the angle-iron stays do not come foul of them.

The height of the boiler-kelsons is arrived at by trying the section of the boilers on the section of the ship at the narrowest part of the boiler space, leaving about three inches clear from the frames of the ship to the corners of the boiler. This method, of course, brings the boilers as low as possible. Square across from the corner of the boiler, and figure the height from the upper line of keel. The position of the blow-off cocks must be determined now, so that the kelsons and frames of the ship may be bent if necessary (as shown in Fig. 3)

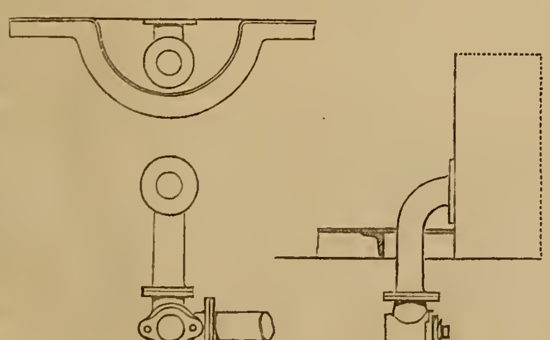


Fig. 3.

to allow the pipes to be arranged under the firing-floor, which is always on a level with the bottom of the furnace, so that the ashes can easily be removed. The boiler-kelsons may be made of single plates and angle-irons. These kelsons, as tending to stiffen the ship, and forming an equally efficient resting-place for the boiler, should run fore and aft in the vessel.

The hatchways for the engines and boilers are to be made as small as possible. A large hatchway weakens the ship, and is of no use. For the engines, it should just be large enough to admit the bed-plate, or cylinder, or entablature—the largest part of the engine, in fact. It is not usual to use the space above the engines for any purpose except for a passage into the engine-room, and for supplying air thereto. The hatchway is plated or boarded up to a deck-house in most screw-steamers. The boiler-hatch is to be clearly shown, and the beams for carrying the deck over the boiler must be left loose. It is well to colour them clearly on the drawing, and direct the shipbuilder to leave them unfixed till the boilers are put on board. When the boilers are placed in the wings of the ship, as in the *Great Britain*, the hatch need not be carried across the ship completely; because, when one boiler is lowered, it may be backed into its position under the beams of the deck, and the second and opposite one lowered close to it into the midship firing-space, and then backed to its proper place. Thus, for two boilers 12 feet long each, and with 8 feet firing-space, we should require a hatch about 26 ft. wide—16 ft. 3 in. on one side the centre of vessel, and 9 ft. 9 in. on the other. This would admit a steam-chest carried from one boiler to the other, with the take-ups united in one funnel in the centre, and leave ample room to get the boilers down even without shifting the first one further from the centre than the half of the firing-space—that is, 4 feet.

The contents of the coal-bunkers may be calculated when the outlines of the engine and boiler are put down. It will be seen at once if there is space to "trim coals" behind the boilers. At each side of the engines there is generally sufficient space to make it worth plating up as bunker-room. From 48 to 45 cubic feet are allowed as space for one ton—the former is perhaps the best figure to estimate from. From the Report by the Commission appointed in 1845 by the Lords of the Admiralty to inquire into "the comparative value of British coals for steam purposes," it appears that in coals of equal evaporative power a difference of twenty per cent. in the space required for storage is often observed, and that the average space occupied by Lancashire coal is 44·491 cubic feet, and by Newcastle 45·100 feet. The coal from Rushy Park Mine, in Lancashire, under the heading of "*space occupied in store in cubic feet*," is stated to require 47·65 to store a ton; that from Blackbrook, Rushy Park, requires 40·50 cubic feet; Davison's West Hartley, Newcastle, requires 46·96; and Andrew's House, Tanfield (Newcastle), 42·99. The average is taken from twelve samples of Lancashire coal, and thirteen of Newcastle.

If, from the proposed arrangements of machinery, it is anticipated that a great fall of shaft will be necessary, it must be provided for in the ship-drawing as nearly as possible. The shipbuilder must give the supposed distance from the stern-post to the centre of engine; in the oscillator, the centre of the condenser and intermediate shaft is the most convenient standard to work from. Suppose, now, that the screw is to be made in diameter 15 feet; from the bottom of screw-space—that is, the upper line of keel,—figure the centre of the boss on the stern-post for passing the screw-shaft through, so that about three inches clearance is left from the edge of the propeller-blade. This will be 7 ft. 9 in.; and if the shaft were to be run level to the engine-room, the height of pinion pedestal centre would, of course, be 7 ft. 9 in. also; and distance between centres of wheels, supposing the engine-shaft to be 17 feet from the keel, would be 9 ft. 3 in. This would answer very well, if there happened to be wheels suitable. If it was determined to make the gearing in the proportion of $2\frac{1}{2}$ to 1, or 5 to 2, the distance 9 ft. 3 in. = 111 inches; so the radius of wheel would be $\frac{5}{7}$ of 111, radius of pinion $\frac{2}{7}$ of 111.

$$\frac{111}{7} = 15{\cdot}857 \times 5 = 79{\cdot}285, \text{ radius of wheel.}$$

$$\frac{111}{7} = 15{\cdot}857 \times 5 = 31{\cdot}714, \text{ radius of pinion.}$$

110·999, or 111 inches between centres,

Thus, practically, the wheel is 13 feet $2\frac{1}{2}$ inches diameter; the pinion, 5 feet $3\frac{1}{2}$ inches.

But if the wheels are necessarily smaller in diameter, the engine centre and screw remaining the same, the pinion end of the screw-shafting must be raised in proportion. The *length* between the engine centre and stern-post must be ascertained, also the *difference* between the height of screw centre and height of engine centre—(radius, &c., of wheel + radius of pinion); and this last dimension divided by the former, gives the rise or fall per foot of the shaft. Thus—

	ft.	in.
Screw centre above keel, 7 ft. 9 in.; crank shaft centre above keel...	17	0
Centre to centre of wheels	7	0$\frac{5}{8}$
	9	11$\frac{3}{8}$

Height of pinion centre, 9 ft. 11$\frac{3}{8}$ in. — 7 ft. 9 in. = 2 ft. 2$\frac{3}{8}$ in.

We thus find the centre line of pinion to be 2 ft. 2$\frac{3}{8}$ in. above the centre of screw; that is, a line must be drawn from the stern-post centre to a centre 2 ft. 2$\frac{3}{8}$ in. above it on the engine centre line. This will show the position of the shafting.

The inclination per foot is then to be calculated. Say the distance is 107 ft. 6 in. between engine centre and stern-post horizontally; as 107 ft. 6 in. is to 2 ft. 2$\frac{3}{8}$ in. : 12 in. to .24 in. The shaft then falls .24 in. in every foot of length from the engine-room. If, then, the engine-kelsons longitudinally were 20 feet long, 10 feet on each side of the transverse centre line of condenser, at one end the height would have to be figured .24 × 10 = 2·4 inches higher than the other; the after end, of course, being the lowest. So the heights of the bearings are fixed by multiplying their distance from the centre line of engine by .24, and adding the result to the height of screw-centre, or subtracting it from the height first calculated and marked on the engine centre line. But this is encroaching on the description of the next drawing—the shafting-plan. It was necessary to enter into the discussion of the inclination of kelsons, so as to enable the engineer to complete the ship-drawing. An approximation can be got very nearly to the right dimensions, and supposing that the position of the engine-room is shifted a few feet fore or aft from the centre first given by the shipbuilder, it will not materially inconvenience the erector of the engines, when he finds that the inclination of kelsons differs from the first plan, provided they are made to the sketch given above—that is, with wood projecting above the iron—as the projecting part can easily be cut away till the bed-plate assumes the right angle.

We have not given full drawings of these kelsons and beams, because both old and young students will be sufficiently familiar with them. This system of commencing a "*screw job,*" however, will enable the young student to methodise his practical knowledge; and as it can be done in many other ways, will either show him where he diverges from the direct plan, or reassure him in the other methods he may have seen used. We propose, in subsequent numbers, to describe the shafting-drawing and pipe-plan, describing the details of both.

AMERICAN NOTES.—No. I.

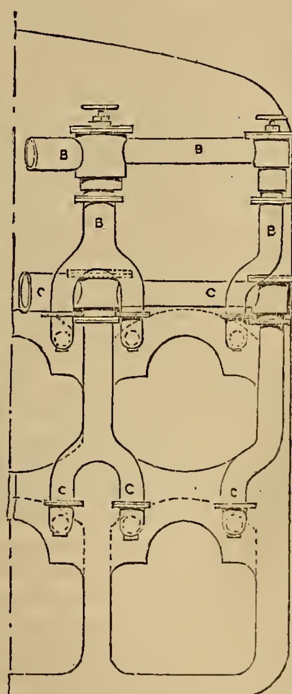


Fig. 1. Front View.

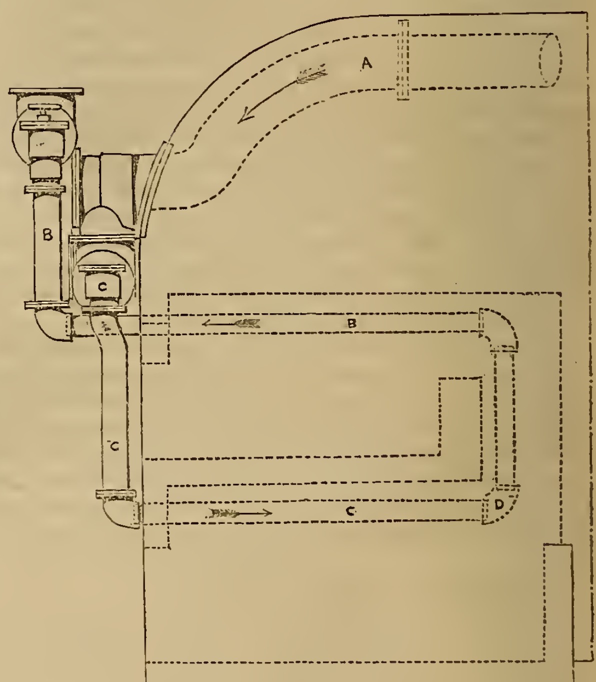


Fig. 2. Side Elevation.

STAME.—As many of your readers have no doubt read of the novel arrangement that was in progress of being introduced into the boilers of the United States mail-steamer *Arctic*, of the Collins' line, at the time of her loss, it may be of some interest to them and others to have a short history of what has been done in this country, having in view the use of superheated or surcharged steam.

In 1849, James Frost, of Brooklyn, Long Island, alleged that a volume of steam heated out of contact with water was doubled by the addition of four degrees of heat, tripled by the addition of sixteen degrees, and increased tenfold by a temperature of 440 degrees; and, in support of this startling position, he, by the aid of a bent tubular glass instrument and a saline bath, did exhibit the result he claimed; admitting his premises, that the steam he used was free from contact with any water. He at the same time submitted to observation an admirably-constructed non-condensing steam-engine and boiler, so arranged as to develop the utility of using superheated steam—or, as he termed it, *stame.* In this arrangement he passed the steam-pipe through the furnace in a coil, and, by the aid of an asbestos packing to the cylinder-piston, he worked the engine; and, by the application of a friction-gear, he declared the result to be highly economical of fuel. The arrangement, however, was not, in my opinion, adapted to the purposes of a just comparison, and no reliable inferences could therefore be deduced, either from the fuel consumed or the work performed.

It so occurred, however, that his experiments were so far satisfactory to some who witnessed them, as to lead them to become interested with him in the further development of his views. As for myself, Mr. Frost having failed to satisfy me of the accuracy of his experiments and consequent reliability of his developments, I decided to await the construction of a more perfect instrument before I gave the subject the attention I was called upon to bestow upon it.

At the time of my witnessing these ever-to-be-remembered experiments, there were presented to me some elements of so novel a character that it may not be amiss to refer to them.

The boiler and engine used were enclosed within an insufficiently-lighted building, of limits barely sufficient to enclose them. The only way to reach the boiler front was by stepping over the working parts of the engine; and what might have been an open platform space between the engine and boiler, was occupied by the steam-pipe, which was reticulated upon this platform in its way to the steam-chest. All this, however, refers merely to the simple question of convenience of locomotion about the engine; and so far as that was concerned, it does not deserve especial notice. But when it is taken in connexion with the circumstances that the friction-gear had a noise peculiar to itself, not to be compared with a Chinese gong for melody—that the *stame*, from its high temperature, licked up everything liquid in the form and consistency of a lubricator, and consequently that the cylinder piston and rod appeared to vie with the friction-gear in its noise—*that the "steam-pipe" for its entire length from boiler to steam-chest was of a bright red*, and that when one of my associates, from an impulse he has not as yet satisfactorily accounted for, ventured to take a cigar, it was very *coolly* lighted for him from a vent-cock in the cylinder head,—I trust your readers will agree with me that it was an occasion well calculated to be referred to from some memorable features. It was, in fact, the first time I was ever sorry to find a full supply of water in a heated steam-boiler, and an obstinate feed-pump that would work in despite of our wishes to the contrary.

How much farther this system of experiments was carried out I do not know, as the demands upon my time and my inclination, as before expressed, precluded any subsequent visits to Mr. Frost and his entertainments. Not long after this, however, he submitted his theory to the American Academy of Arts and Sciences at Cambridge, Mass.; and the Rumford Committee of its members, using their own instruments, investigated it, and reported the following results:—

Degrees.	Experiments.	Frost.	Differences.
212°	1,580 parts	1,580 parts	—
216°	1,600 „	3,160 „	1,560
228°	1,630 „	4,740 „	3,110

The whole expansion of steam, when raised from 212° to 228°, was but a little more than one-thirtieth of its volume at 212°. According to Mr. Frost's theory, it should have been more than ninety times as great as this Committee found it to be.

Soon after this, Mr. Frost died, and *stame*, so far as my observation extended, was seldom referred to, until 1853, when Messrs. C. E. & S. Wethered, of Baltimore, Ma., obtained a patent for the use of steam and superheated steam (*stame*) combined. These gentlemen at once addressed themselves to Mr. Collins, and he, in a spirited and liberal manner, at once entered upon a series of experiments upon a large scale, for the purpose of testing the practicability and utility of the combination; and, after a fair investigation of it, he decided to apply the means necessary to develop it in the engine of the *Arctic*, and wrought-iron tubes were led from the upper part of the steam-chimney through the furnaces of the boiler, thence through the fronts of the boilers into the steam-pipe, after the manner of the accompanying sketch, in which A is the inner steam-pipe, through which the steam passes from the boiler through the pipes C C, and thence into B, being converted in its passage into *stame*.

When this arrangement was completed, steam was raised, and the vessel entered upon a trial-trip; but she had not proceeded far before one of the elbows at D in one of the furnaces gave out, and, upon an investigation and consideration of the circumstances, he decided to remove all the tubes, and replace them with others lined with enamel. Pending this, the vessel entered upon her service, and was soon after lost. As yet, I have not learned of any new steps having been taken to introduce the application into practice: if, however, the mechanical difficulties attendant upon its application can be readily overcome, there can be no doubt of its general adoption, as it has been clearly and undeniably shown that the saving of fuel by it is very great—in some cases it is alleged to have reached 53½ per cent.

Steam-tug "Leviathan" (New York Harbour).—The following details of this vessel are not given having in view the mere furnishing you with the particulars of construction of an ordinary American steamer, but they are given to you as the exact dimensions and reliable elements of performance of the fastest American sea-steamer yet built; and if the speed of wheel here given should appear unreasonable to any of your readers, they are advised to bear in mind that this vessel was built solely for towing vessels in and out to sea. She presents, therefore, to the air no other obstructions than the indispensable ones of her water-wheel, engine and pilot houses, low bulwarks, engine-frame and chimney; added to which, her model is well adapted to high speed, and she has most successfully developed the intentions of her spirited owners, Messrs. Spofford, Tileston and Co., of this city.

DIMENSIONS OF STEAM-TUG "LEVIATHAN." HULL BUILT BY ECKFORD WEBB ENGINES BY ALLAIRE WORKS, NEW YORK.

	ft.	inches.
Length on deck	179	0
Breadth of beam	29	3
Depth of hold at ditto	11	6
Hull	500 tons.	

Kind of engines, vertical beam; do. of boilers, single return flues. Diameter of cylinder, 60 inches; length of stroke, 10 feet; diameter of wheel over boards, 29 feet 4 inches; length of blades, 8 feet 4 inches; depth of do., 2 feet 4 inches; number of do., 21; number of boilers, 2; length of do., 28 feet; breadth of do., 10 feet; height of do., exclusive of steam-chests, 9 feet 10½ inches; number of furnaces, 4; breadth of do., 4 feet 4 inches; length of fire-bars, 7 feet 7½ inches; number of flues, 15 (10 below and 5 above); internal diameter of do., 12¼, 16, and 18 inches; length of do., below, 15 feet 5½ inches; do. do., above, 21 feet 9 inches; diameter of chimney, 5 feet 5 inches; height of do., 64 feet 5 inches; heating surface, 2,927 square feet; load on safety-valve, in lbs., per square inch (maximum), 30; area of immersed section, 176 square feet; fuel, anthracite, with a natural draught; contents of bunkers, in tons, 30; consumption of coals per hour, 1 ton; draft, forward, 8 feet; do., aft, 8 feet; maximum revolutions, 22. Masts, none. Intended service, towing.

The pressure of steam above given, and the number of revolutions of the wheels, are a maximum, but are yet such as can readily be obtained with good fuel and fresh water in the boilers. The ordinary pressure of steam is 20 lbs. per square inch, which gives 18½ and 19 revolutions.

Unlike the general practice here when anthracite coal is used for fuel, the furnaces of this vessel are not provided with blowers: the pressure of steam, therefore, is full 20 lbs. less than what might readily be obtained were they added to her.

The speed of periphery of wheel here obtained by 22 revolutions reaches the high velocity of 23 statute miles. The deduction to be made from this for slip of wheel-blades I will leave your readers to estimate for themselves; but they must not lose sight of the fact that the cross area of one water-wheel blade is within a fraction of 19½ square feet, which, doubled for the two wheels, gives 39 square feet of cross area of blade for 176 square feet of immersed section.

The Caloric Ship "Ericsson" has had all the machinery peculiar to the caloric principle removed, and her engines are now being fitted with fresh-water condensers. Her boilers are in progress of construction, and it is expected that she will be ready for sea on the 1st February next.

The "Great Republic."—The hull of this mammoth clipper-ship was bought at the Underwriters' sale by Captain Palmer, of New York, and it is now rebuilt and nearly rigged anew. One deck has been removed from the depth, and in lieu of her four masts and divided topsail-rig, as she was originally fitted, she has but three masts and spars of the ordinary arrangement.

Improvement in Bottles for Effervescing Fluids.—Mr. H. T. Brown, of Brooklyn, New York, has invented a new method of retaining casks and bottles, whereby all other means than the mere friction of cork is rendered unnecessary. It is effected in this way:—The mouth of the bottle has a tapered opening, at an angle of 45 degrees, intersecting the opening of or the neck of the bottle. Through this opening the cork is introduced, and the pressure of the fluid, instead of acting upon the bottom of the cork and forcing it up, acts in this case only on a part of the side of the cork, and thereby the ordinary resorts of wiring, &c., are rendered unnecessary: in fact, a corkscrew becomes almost useless, as a pointed instrument introduced against the under or small end of the cork will readily force it out. This is a good idea, and, when glass-blowers have attained the dexterity necessary to form this peculiarly-shaped mouth to a bottle, I have no doubt of its being generally adopted.

The Teredo Navalis, a Worm.—A Mr. Swan, of the State of New York, alleges that he has discovered a new method of preserving submerged timber from the effects of this destroyer of wood in Southern waters. It is the application of a mixture of

Asphaltum..................	100 parts.
Sulphur	40 „
Arsenic	20 „

The whole mixed together and used as a paint: the asphaltum first to be melted, the other materials stirred in, and the whole applied with a brush to the wood in a dry state. A Maine railway painted in this manner has withstood the worm for eighteen months, whilst timber unpickled and laid by its side has been twice laid and removed as useless from the effects of the worms to which it was exposed. H.

REVIEWS.

INTERNAL COMMUNICATION IN INDIA.

1. *Public Works in India; their Importance, with Suggestions for their Extension and Improvement.* By Lieut.-Colonel A. Cotton. Second Edition. London: Richardson. 1854.

2. *Observations on Colonel Cotton's proposed System of Cheap Railroads for India.* By a Madras Officer. Madras: Pharoah & Co. 1854.

(Continued from page 269.)

The author of the "Observations on Colonel Cotton's proposed System of Cheap Railroads in India" takes exception to the doctrine that cheap and less artificially constructed railways than are usual in England, are best adapted for the circumstances of India; but he maintains, on the contrary, that railways of the kind now being constructed there are the best that could be made. We cannot discern much cogency in the arguments by which this view is supported, but we shall enable our readers by a few citations to form an opinion on the subject for themselves. As a fair example of the style of argument, they may take the following:—

"I differ from Colonel Cotton, and consider that the construction of the trunk lines of railways, as now sanctioned, is not only one of the boldest, but one of the wisest measures that the Government of this country ever undertook; that it especially marks the commencement of a new state of things amoug the people—new principles of government among their rulers.

"I believe that anything short of these works—such, for example, as these tramways, or low-speed railways—would fail to answer the same purpose; that, beneficial to some extent, they would be wanting in the very characteristics most essential to us here; that they would ultimately rather retard than promote the dissemination among the people of that moral and intellectual light, upon which, and which alone, their advance in material wealth must depend.

"It is not my intention to enter into any discussion of the various topics introduced by Colonel Cotton in connexion with the public-work question. In fact, I find 'one idea' enough for any ordinary man of business to deal with at a time.

"My business is not now with the important question of irrigation, nor making of salt, nor even the general value of water to a thirsty people —but the roads, or rather the railroads, as they ought to be, and as I hope and believe they are about to be.

"I propose, therefore, to consider some of the arguments which Colonel Cotton has advanced in favour of his own views, and in objection to the present undertakings.

"That officer proposes a system of tramways* in preference to railways, on the score of economy; economy in time—economy in first cost—resulting, according to his calculations, in the saving of enormous sums of money within a few years.

"In attempting to prove this, Colonel Cotton has, as I shall show,

"1st. Overstated the cost of railways.

"2nd. Underestimated the cost of tramways.

"3rd. Greatly overestimated the time required to lay down the railways.

"4th. Almost as much exaggerated the facility with which the tramways might be constructed.

"5th. His calculations are vitiated throughout, by his claiming for this cheap and inferior description of railway, not merely an equality, but generally absolute superiority over the more perfect and expensive work, in respect to cost of traction* and working expenses; thus, in fact, begging the whole questiou—since it is solely and entirely with a view of reducing to a minimum these very costs, that greater outlay is recommended in the construction of the 'railway.'

"It is not necessary that I should take the Colonel's calculations page by page, for the above errors lie at the bottom of them all.

"There are, however, other points in which Colonel Cotton's arguments are seriously defective. He omits, or makes only an occasional passing allusion to, the superior *capacity* for creating traffic possessed by the railway. In his calculations it is ignored wholly.

"While pointing out one line in India (the Bengal) which will have more traffic upon it than it can carry, and highly estimating the probable traffic on other lines, he recommends tramways for all, and seems to overlook the fact that their capacity for performing any amount of work is far below that of railways.

"Further, Colonel Cotton assumes an arbitrary and variable, though generally much too large, amount of traffic; confounding traffic that is or may be supposed to exist, with that yet to be created by the very works in question.

"He thus exhibits enormous sums of money 'lost' while the railways are being laid down; the fact, as applied to this country at large, being, that the traffic at present is light, and that we must look to the railway as the instrument best calculated to stimulate and extend it.

"The object of constructing a perfect railway is, to facilitate the most economical application of steam as the motive power. The one great object in view in the construction of and other arrangements connected with this or that particular line of railway is, or ought to be, the most economical, most effectual, and, therefore, most beneficial employment of that power.

"This is the problem on the solution of which depends the gauge, the weight of rails, the curves, the gradients, &c."

Here, then, we have the grounds on which this writer rests his opinion, that a few miles of dear railway are better for India than many miles of cheap railway. Now, without going into the question whether Colonel Cotton has set down his tramways at too low a rate, and the existing railways at too high a rate, we are at least certain that railways, like everything else, may be made of an inferior quality at a low price, or of a superior quality at a high price; and the whole question is, which quality is best for the circumstances of India? The author before us maintains that the dear railways are the best, because they are able to carry more cheaply. But this statement is the reverse of the fact, as they are only able to carry more quickly. In England we have a dear system of railways, and in America we have a cheap system of railways. In America it is found that cheap railways are profitable, where dear railways would not pay eveu for their own depreciation; and as the circumstances of India more nearly resemble those of America than those of England, the question arises, whether we shall not introduce into India that class of railway which in countries the most nearly resembling it has been found to be the most suitable that can be adopted. This, however, is not the whole question. If cheap railways are the most eligible for India, supposing we had an unlimited sum of money to spend, does not the necessity of their selection become still more exigent when the means at our disposal are limited? If we have an army to clothe with a limited fund, shall we dress a few in broad-cloth and let the rest go naked?—or shall we not rather content ourselves with a cheaper material, in order that all may have something to put on? Colonel Cotton's view of the propriety of accomplishing the largest and speediest ameliorations at the least expense is one that cannot be controverted or gainsaid; but it is practically resisted by the jobbers of the India House, who wish to have expensive railways on other grounds than those which are adduced to the public. Expensive railways offer larger margins of many kinds, and therefore they are more popular with those who anticipate advantage to themselves from the large expenditure and disarranged state of a new department not yet brought under efficient control. It is not *railways* these people want, but *expenditure:* they want extravagance, confusion, and imperfect reckonings; and they, consequently, resist, and have hitherto resisted successfully, the enterprises of those who considered merely, as Colonel Cotton has

* "I use the term as conveying to the general reader a more correct notion of the question at issue than that of low-speed railway as applied to the one, and high-speed to the other. The works proposed for India are railways as generally understood—not 'high-speed' railways."

* "In one place (page 140) the Colonel assumes, that whatever difference there may be in the cost of traction on the two lines, would be made up by the greater speed of the railways; which cannot be allowed."

done, what benefits could be rendered to India in the cheapest and best way, without seeking to conciliate harpies who are to be satisfied, not by argument, but by spoil.

We do not attribute any such corrupt motives to the author of the "Observations" before us: on the contrary, we believe him to be sincere in all his views. But he is only a feeble advocate of weak opinions, and there can be no impropriety in supposing him to be the dupe or cat's-paw of those more diplomatic spirits who would not wish to appear on the stage themselves. This state of things, however, cannot last much longer. All expedients of pursuasion and conciliation having been tried in vain—or rather, we should say, all *honourable* expedients—it will now be necessary to brush away such pigmies as the author of these "Observations," and to tear the mask from those who are the dark movers of the obstructive cabal. We know them well: we know their motives; and we know more of their deeds, probably, than they suppose. We have been long-suffering, and have had infinite patience; but conciliation has its limits, which becomes mere weakness when overstepped, and now we declare war. Already they know whether we can wage war with vigour or not, and now they shall feel it. It is with the East India Company our war is. We scorn to trifle with them longer, and we shall now do our best to rout them out. Heretofore they have defied public opinion: they cannot now do so, as they only exist upon sufferance; and we will stick to them in season and out of season, until we have pulled them down, or until they have purified themselves of that corruption which now provokes our animadversion.

RAMBLES AMONG THE REAPERS.

By Robert Scott Burn.

(Continued from page 267, vol. xii.)

The next notice of a reaping-machine we meet with is in Walker's "System of Familiar Philosophy, in Twelve Lectures." There are many points of resemblance between this and our recently-invented machines; indeed, in point of arrangement it is quite equal to some of our very recent patents. The cutting apparatus is a flat disc, or wheel, to the circumference of which are fixed a series of knives, or scythes, seven in number. These knives are circular on one, and flat on the other edge; the flat is sharpened, and forms the cutting edge. In front of the cutting-wheel, a series of sharp-pointed steel blades are placed; these enter the corn as the machine advances, and bring it up to the action of the cutting-knives: the edges of the steel points being sharpened, serve also as a kind of scissors, or shears, to cut the corn. The corn, after being cut, is laid in swathes on each side of the machine, as it is *pushed forward*, by the revolution of an iron rod, which is fastened at one end to the upper end of the spindle of the cutting-wheel: as this revolves, the corn is caught by it and laid at the side of the machine. Provision is made to prevent the corn from being returned amongst the standing corn, as would be the case by this arrangement when the machine was driven in the return direction. This is effected by substituting another rod, or lever, the point of which stands perpendicularly, and at each revolution strikes the end of another and horizontal lever, which sweeps the corn aside. A small wheel is placed in front of the machine on a pointed plate; by fixing this wheel at any desired height, the stubble can be left short or long as required. This machine, although produced at so early a date, and the name of whose inventor is so completely unknown, contrasts by no means unfavourably with some recently introduced, and about the merits of which some considerable talk has been made.

We now come to the era of patents, when inventions in this department were no longer exclusively made public by means such as we have already pointed out, but were considered worthy of the honour of a Government protection, and of consignment to the musty rolls of the Patent Office; a consignment which not unfrequently is tantamount to that of oblivion—the Record Office being somewhat in its influence like the famous "tomb of all the Capulets," to which time out of mind, since Shakspeare's days at least, so many inventions have been so unceremoniously bundled. We trust that the labours* of Mr. Bennet Woodcroft, the able and well known Superintendent of Patents, will tend to rescue from an oblivion, which might otherwise have been their fate, many inventions of merit in this department of mechanism. A digest of the contents of the work as undernoted may also in some measure effect the same, and through the medium of our own pages.

The first recorded patent is that granted to Joseph Boyce, of Middlesex, 4th July, 1799. The cutters in this machine were a series of six knives, fixed on a horizontally-revolving disc—these knives being placed in the front of the machine—the corn being laid smooth up to the knives by means of a guard in front of the knives, which could be altered as required. No means seem to have been adopted for laying the corn properly, so as easily to be gathered up.

On the 20th of May, 1800, a patent was granted to Robert Meares, of Frome, dyer, for a mechanical reaper. From the terms of the specification, this seems to have been merely a large pair of shears, the handles of which were worked by the man who pushed it forward among the corn—the shears, to facilitate this, running on a small wheel or wheels placed in front, but behind the points of the shears; the corn being laid regularly on each side by means of wires, so placed on one side as to conduct it to the ground, and on the other to throw it over to the other side.

Thomas James Plucknett, of Deptford, obtained a patent on the 23rd of August, 1805, for a "machine for mowing corn, grass, &c." No drawings accompany this description; but Mr. Woodcroft has prepared three views, which give an idea of the probable method in which the arrangement was carried out. The cutter seems to have been a flat disc, the periphery of which was brought to a fine cutting edge; this revolved horizontally in front of the machine, and the spindle, or shaft, worked inside a hollow spindle, so that on meeting any obstruction the disc and shaft were raised so as to clear it. A series of horns, or leaders, projecting in front of the machine, brought the corn up to the revolving disc, or cutter.

The next machine we have to notice is not a patent one, but was introduced by Mr. Gladstone, of Castle Douglas in Scotland, at first under the patronage of the Highland and Agricultural Society; but this having been on some account withdrawn, latterly under that of Sir Edward Crofton, who happened to see the model, and ordered one on his own account.

Mr. Woodcroft gives drawings and descriptions of this machine, extracted from Brewster's Encyclopædia, vol. i., p. 286.

The cutter was formed of a disc, the periphery of which was brought to a sharp edge. The corn was brought up to this horizontally-revolving disc by a series of prongs projecting from a cover, or shield, which was placed over and before the disc. The edge of the cutter was capable of being sharpened without stopping the action, this being effected by small circular pieces of wood covered with (emery ?) a substance to act upon the iron, these circular pieces revolving rapidly.

This is the first machine met with in which mechanism was used to gather the corn cut and lay it in regular bundles. A wheel, termed the "gathering wheel," revolves horizontally with the axis of the cutter; to this wheel a cross arm is attached, to the end of which the "gatherer" is fixed. As the wheel revolves, the gatherer takes up the corn; but, to prevent it being carried completely round, a small piece of wood takes the corn out of the gatherer, leaving it in small sheaves, or handfuls. The gatherer is supported in one position by a segment of wood, but which affords support only for a certain period of the revolution of the gathering wheel. This machine is not pushed forward, as in the others we have noticed, but is drawn, the horse being at the side of the machine.

In all the machines here noticed, the cutting is performed by the

---

* Specifications of English Patents of Reaping-machines from 1799 to 1852, with an Appendix, by Mr. Bennet Woodcroft, Superintendent of the Specifications in the Patent Office, and late Professor of Machinery in University College, London. Published, under the sanction of the Commissioners of Patents, by George Edward Eyre and William Spottiswoode, Printers to the Queen's Most Excellent Majesty. Price £1 10s. 7½d.

cutters having a rotatory motion. In the machine introduced by Mr. Salmon, of Woburn, and described in the vol. for 1807 of the "Farmers' Dictionary," the cutting is performed by knives having a clipping or reciprocating action. The corn in this is brought up to the action of the knives by pointed plates, which cover the fixed knives. To separate the corn to be cut from that left standing, a projecting bar is placed in front of the machine. The corn is delivered at one side by the action of a rake, being a long, narrow framework, which has an oscillating motion given to it by means of a crank, the shaft of which is drawn by toothed wheels.

Like the preceding machine noticed, this was soon laid aside from the defects of the gathering apparatus.

We now come to notice the reaping-machine introduced by Mr. Smith of Deanston, the celebrated agriculturist, and which was in partial use during the harvest of 1811. In this machine the cutter and gatherer were combined; the latter being formed of a conical drum, the small end being nearest the ground. This was made of tin-plate or basket-work, and covered on the outside with canvass and perpendicular rows of soft rope, to increase the friction upon the corn as it was carried round. The circular cutter, of six segments, was attached to the under side of the drum, and projected about five inches beyond its lower part. The machine, on being pushed forward by the horses, by means of appropriate mechanism communicates rapid motion to the drum and cutter. "The corn is cut by the rapid motion of the cutter; and as the lower ends of the stems rest upon the edge of the cutter, and the heads come in contact with the drum, the whole is carried round and regularly laid by the side of the machine. The lower extremities take the ground first, the heads fall outwards, and the stalks are laid parallel to each other, and nearly at right angles to the line of motion of the machine." The drum was capable of being lifted up out of the reach of any obstacle by the driver.

Trials of this machine were made, and showed that about an acre per hour could be cut with it, the blades requiring to be sharpened during this period four times—the operation of sharpening taking up about two minutes. The Dalkeith Farming Society having offered a prize for an effective reaping-machine, Mr. Smith's machine was the only one offered for competition. This was in 1812. On this occasion the corn was well cut, but laid irregularly. In 1814 it was again exhibited before the same Society, who reported that the corn was now better laid, but imperfectly cut. The most successful trial, however, was made before the Committee of the Highland Society of Scotland, who were so thoroughly satisfied with its apparent efficiency, that their report was the means of eliciting from the Society no less a favour than a piece of plate of the value of fifty guineas. A complete model of the machine at this stage was at the same time presented to the Museum of the Society by Mr. Smith. In the trial above noticed, an acre of beans was cut down in an hour and a quarter.

From time to time this machine was brought before the public, and each time seemed to renew the hopes that the problem of a successful reaping-machine was solved. At length, in 1835, an important trial at the Agricultural Society's show at Ayr seemed to decide the point, so striking was its success; nevertheless, says the historian of the day's work, "the machine remained, and to this day remains, without making further progress." At this trial, the corn was gathered not only by the conical drum, as before, but by revolving rakes, the idea of which Mr. Smith appears to have obtained from the machine of Mr. Mann, of Cumberland, hereafter to be noticed. In the improved machine, the cutter was capable of being driven either from right to left, or *vice versa*, so that the direction in which the corn was laid could be altered as desired. As this machine is one of the few invented which have gone further than the rolls of the patent office, the pages of a cyclopædia, or the status of a model, we deem it advisable here to give an extract which details the probable reasons why this machine, so apparently efficient, fell into disuse. For this we are indebted to the very able Report on Reaping Machines by the well-known Scottish mechanician, Mr. James Slight of Edinburgh, presented to the Highland and Agricultural Society of Scotland (see p. 183, No. 35, "Journal of Agriculture"). "It is more than probable that the failure of this machine rested mainly on the defective points: 1st, from its great length and weight, it was unwieldy in all its movements; 2nd, from its great length, also, and from the mode of attachment of the horses, together with the want of a swivel carriage either before or behind, it was defective in turning at a landing; and, 3rd, from the small diameter of the bearing front wheels, and especially from their being placed nearly direct under the centre of the revolving cutter, this last and most important member, when these wheels fell into a furrow, ran right into the brow of the adjacent ridge, and thus destroyed, for a time, the whole edge of the cutter—its projection before the wheels being nearly 2½ feet; and, 4th, it may be stated as an objection, namely, the price, which probably could not have been much under £50."

Almost simultaneously with the introduction of Smith of Deanston's machine, came that of Mr. A. Kerr, of Edinburgh; and so alike in principle and arrangement, that each gentleman claimed the priority of invention. This, no doubt, may be taken as an instance of the coincidences met with in the experience of mechanics. The drum—to which the cutter was attached, as in Smith's machine—was supported by two wheels, placed in its *interior;* these wheels were made heavy, as they gave motion to the drum. The axle of these wheels was provided with a catch, which was carried round with the axle when the machine was pushed forward, but so fixed as to leave the axle free when drawn backwards. The movement of the drum was effected by toothed vertical wheels, entering into a horizontal pinion on the shaft of the drum. Although this arrangement, as Mr. Slight remarks, is obviously inadequate to move the cutter with the necessary speed, a recorded trial of the machine seems to prove that it nevertheless was efficient. The inventor also received a premium of twenty guineas from the Highland Society. A model of Mr. Kerr's machine is placed in their Museum.

We now return to the notice of the patent reaping-machines.

Following that of Mr. Plucknett, already described, is the patent granted to Mr. Donald Cumming, of Northumberland, the 20th July, 1811. There is considerable novelty in the arrangement of the cutters; but it is to the existence of the revolving rake, or gatherer, that its chief claim to notice lies. This appliance, more or less modified, is the one which is used in nearly all modern machines; and the machine of Mr. Cumming is the only recorded one, apparently, in which this effective contrivance was adopted. The body of the machine is formed of a triangular base, the apex of which is pushed forward among the corn. On each side of the triangle, a series of toothed cutters of small diameter revolve horizontally, the edges of which project before the flat tables on which they revolve. The corn is brought up to the cutters by a series of projecting holdfasts. The main driving-wheels are placed behind the triangular frame, a small guiding-wheel being situated within the triangle, near the apex. The attendant sits on a seat above, and slightly behind this guiding-wheel. As the machine advances, the corn is cut by the revolving cutters on each side of the triangle—the breadth of the path cut in the corn being obviously equal to the breadth of the base of the triangular frame. The corn is brought inwards as the machine advances by the revolving gatherer, which is placed in front of the machine, and is, in appearance and construction, like a paddle-wheel, the floats of which catch the corn and bring it up to the holdfasts and cutters. As the corn is cut, it is laid on each side in a swathe, passing along the side of the triangle; this being further facilitated by being carried along by endless cloths, which revolve on fluted rollers placed at the sides of the triangular frame. There are many points of resemblance in the principle of this machine to that of the well-known Bell's—the revolving rake and the endless cloths.

On the 23rd of September, 1814, a patent was granted to James Dobbs, of Birmingham, for a reaping-machine, in which a decided novelty is noticeable. In all the machines hitherto noticed, the cutters are driven, by various arrangements of mechanism, from the supporting wheels of the machine. In Dobbs's the cutters are driven by hand, the machine being at the same time pushed forward by the attendant.

Mr. Woodcroft is inclined to think that this method of driving the cutters is worthy of consideration. On this point, he remarks, "cutters moving with sufficient velocity (if that be possible), when driven by the carriage-wheels, require the machine to be very heavy: it is, therefore, suggested, that if the cutters in Dobbs' or any other machine were driven at a high speed,* by a band or other apparatus, from some source of power independent of the machine itself, such a machine as Dobbs', guided by a man, would then do a large amount of effective work. Power from such sources is attainable in various ways well known to machinists."

In the machine now under consideration, the cutting is performed by a series of small circular cutters revolving horizontally in front of the machine. The straw is taken hold of by a pair of rollers or wheels placed over or under the cutters, the periphery of which is rough, to enable them the better to hold the straw. After being cut, the straw is caught by another pair of rollers placed at the back, and which deliver the corn to the cradle behind. At each side of every pair of rollers or feeders, pointed "dividers" are placed: these enter the corn as the machine advances, and assist in drawing it to the rollers and cutters, and also to lay the uncut corn aside. The dividers widen gradually, and are at the same time extended to the top, or nearly to the top, of the back rollers, which stand vertically at the front of the cradle. The cutters are made to revolve by working a wheel placed at the back of the machine between the driving-handles.

Members of all trades and no trades, gentlemen really or self-styled so, seem to have made essays at the invention of a reaping-machine; but Mr. Dobbs stands alone for the singularity of his calling—one which, in its aims and pursuits, is somewhat opposed to those of agriculture: we refer to the theatrical profession, Mr. Dobbs having belonged to the Birmingham Theatre at the period of taking out his patent.

From a notice in "Aris's Birmingham Gazette," which the industry of Mr. Woodcroft has presented us with, we find that, very characteristically, the invention was tried publicly on the stage of the theatre, part of the stage being planted with wheat ("as near as possible in the manner it grows"). This first experiment, according to the same authority, was completely successful.

(To be continued.)

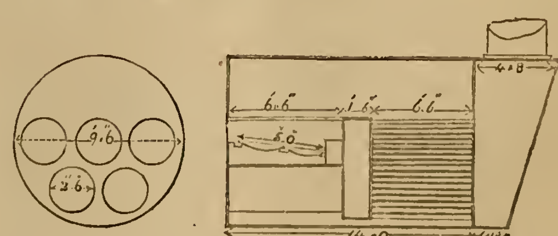
DIRECT-ACTING STEAM-ENGINES DESIGNED AT THE ROYAL NAVAL CLUB, PORTSMOUTH.

These engines, in their general arrangement, resemble Messrs. Penn and Son's trunk-engine; but each engine, instead of being provided with a single cylinder with a trunk within it of sufficient size to permit the play of the connecting-rod, is provided with two cylinders, as in Maudslay's double-cylinder engine, with the connecting-rod working between them. Instead, however, of the T cross-head employed in Maudslay's engine to connect the end of the connecting-rod with the tops of the piston-rods, the piston-rods are brought out of the bottoms of the two cylinders, and are connected by a straight cross-head, from which the end of the connecting-rod springs. The cranks are forged in one piece with the shaft; the air-pump buckets are wrought by rods attached to the pistons, as in Messrs. Penn's engine, and the general features of the engine are the same as those of Messrs. Penn's engine, with the exception that two cylinders are used instead of one cylinder with a trunk. The cylinders, we need hardly add, lie horizontally, and two are on one side of the shaft and two on the other side. The stroke is short. The valves are worked by means of the link-motion; and all modern features of improvement have been apparently introduced with that nice attention to details which might be expected of practical engineers.

Although, however, we believe these engines to be of a more eligible construction than that of many of our existing screw-engines, we do not think they are an improvement upon Messrs. Penn's engines; nor do we think they are the kind of engine that will obtain any very wide acceptation. The designers of this engine probably felt that in Messrs. Penn's engine, notwithstanding its many excellences, the trunk was a weak point—which it no doubt is—and they considered, we suppose, that this defect would be corrected by the substitution of two cylinders. But it happens that the remedy is worse than the disease; and it follows that, instead of producing a better combination, they have produced a worse. We think it a serious fault in any engine to have a needless multiplication of the parts; and besides the complication thus introduced, an addition to the number of cylinders causes an increased radiation from the cylinder surface, an increased leakage of piston, and an increased consumption of fuel. It is a defect of these engines, moreover, that they are not balanced in such a way as to correct the momentum of the moving parts. Upon the whole, we think that these engines would have been very well if produced a few years ago; but they are now too late. We have now got something better; and that being so, there appears to be no likelihood that we shall revert to pieces of antiquated complication. The defects which apply to Maudslay's double-cylinder engine apply equally to this one; and who, saving Maudslay, has ever adopted that species of engine? Its perfections were largely proclaimed, and, we must add, largely accredited, at the time it came out—now more than ten years ago; and at that time we stood alone in denying its virtues and repudiating its pretensions. We predicted that it would never be imitated or adopted—a prediction which has been completely verified by the result; and we should run little risk, we think, in making a similar prediction regarding this engine of the Royal Naval Club, which is, in part, a revival of an exploded and now obsolete scheme. We are gratified to see our naval engineers trying their hand in designing engines; but we are satisfied that they can do something much better than this. Let them burn their crude and early efforts, and try again—bearing in mind that one main condition of success is the fewness of the working parts—and we shall hope to see some designs resulting from their efforts which will be advantageous to the community and creditable to themselves.

BOILERS OF THE "MALACCA."

We give in the accompanying woodcut an outline of the boilers of her Majesty's screw-steamer *Malacca*. This drawing, which is copied



from Adcock's "Engineer's Pocket-book," will convey a tolerably just conception of the species of high-pressure marine boiler introduced by Messrs. Penn and Son into several of the Government steam-vessels. The boilers are cylindrical, and the furnaces, of which there is a double tier, are contained in cylindrical flues set within the boiler. We consider the use of cylindrical boilers to be inevitable in steam-vessels, simply because we think the use of high-pressure steam inevitable, and there is no ready and efficient means of generating high-pressure steam except in cylindrical boilers, as it is impossible to stay flat boilers sufficiently to give the required strength. We are not sure, however, that this is the species of cylindrical boiler that will come into general use. The diameter is too great, and the ash-pits of the furnaces are too contracted. A cylindrical boiler with the furnace beneath it would, we think, be

* A leaden disc made to revolve rapidly against a steel bar will cut it asunder.

preferable; and this species of boiler has, we understand, been introduced by Messrs. John Bourne and Co. with eminent success.

The following are the chief dimensions of the *Malacca's* boiler:—

No. of tubes, 414.				
Length of ditto, 6 feet.				
Diameter of ditto inside, 2 inches.				
Ditto ferruled.				
Surface in fire-grate	625 feet =	·625	feet	per horse power.
Furnace and tubes...	181 do. =	1· 81	do.	do.
Tubes	1,463 do. =	14· 63	do.	do.
Area through tubes	995 ins. =	9· 95	do.	do.
Chimney	1,520 do. =	7· 6	do.	do.
Each boiler equal to 100 horse power.				
The *Malacca* has two of these boilers.				

SPECIFICATION OF A DOUBLE DREDGER TO DISCHARGE OVER THE SIDE.

CONDITIONS.

Extent.—The obligations to be comprehended under this contract are to include all workmanship, carriage, and materials necessary to construct and completely finish, ready for work, a double dredging machine with an iron hull, and stores, agreeably to these conditions, the following specification, and a relative drawing and model, as well as to maintain the same as hereinafter provided.

Drawings, &c.—Although the Clyde Trustees believe the drawing to be correct, they do not guarantee its accuracy, as it is not considered to be more than an outline. On the same principle, although the specification is believed to give a general and pretty full description of the manner of executing the work, it is not intended to specify every detail or part necessary for the completion of the dredger. Contractors will therefore be held to have satisfied themselves of the quantity and nature of work to be done previous to tendering. It is also stipulated, that should the Clyde Trustees consider it advisable to supply detailed drawings of any part of the work during its progress, the Contractor will be required to work to them without any extra charge.

In the event of any discrepancy appearing between the drawing, or model, or specification, the latter will be held to be correct in preference to the others.

Alterations.—The Clyde Trustees reserve power to make alterations on the work before or during its progress; the value of which is to be fixed by the Arbiter hereinafter named, and the contract sum added to, or deducted from, as the case may be.

Maintenance.—The contract is to include the maintenance of the hull and machinery of the dredger, in a perfect and complete state of repair, for a period of six months from the date of the machine being finished and commencing work; at the expiry of which time it is to be left in a perfect state of repair. The obligations for maintenance are not to include fair wear and tear, but will extend to any breakage or damage caused by defective arrangements, dimensions, materials, or workmanship. With the concurrence of the Trustees, therefore, the Contractor will be allowed to increase the strengths of parts, or improve their arrangement; but he will not be allowed to diminish the scantlings of any portion of the work. The Contractor will also be required to provide and pay a competent and steady mechanical engineer to keep and work the engine and machinery until the period of maintenance has expired; and the person so appointed is to lodge on board the machine, and obey the instructions of the master of the Dredger, so far as working the engine, &c. is concerned. In the case of his failure to attend to his duties punctually and properly, it will be incumbent on the Contractor to remove him and appoint another to the satisfaction of the Trustees. Should the Trustees suffer any loss or damage through the misconduct or incompetency of this engineer, the Contractor will be held responsible therefor, to the extent determined by the Arbiter.

Superintendence.—All the workmanship and materials are to be of the best description, and to the entire satisfaction of Mr. John F. Ure, resident engineer on the Clyde Navigation, or to that of any competent person acting under him. In the event of the hull being constructed at a distance from the machinery, the Trustees reserve power to place an inspector over each; but neither the hull nor any other part of the work is to be sub-let without the sanction of the Trustees; and in any case the Contractor will be held responsible for every portion, whether actually executed by him or not.

Time.—The dredger is to be entirely finished, and delivered completely equipped and ready for use, on or before the 1st day of June, 1855; failing which, the sum of £20 will be deducted for each week thereafter that it may not be so delivered. On the other hand, the Trustees will pay to the Contractor an equal sum for every week that it may be so delivered before the time above stipulated.

Clyde Dues.—The usual dues on materials for the work, if carried on the Clyde, or crane dues for lifts, are to be paid by the Contractor, the Act of 1840 notwithstanding.

Finished Drawings.—The Contractor will be required, on the completion of the work, to furnish the Trustees with neat and correct drawings of the dredger as executed, to a scale of one twenty-fourth, with details of the principal parts to a scale of one-sixth, full size.

Payments.—Interim payments will be made on certificates of not less than £3,000 at a time, to be granted by the Engineer to the Clyde Trustees; and within two months after delivery the balance will be paid to the Contractor, less ten per cent. on the contract sum, *plus* the estimate for maintenance, which will be retained by the Clyde Trustees until the period of maintenance has expired, and the Contractor relieved of all liability in reference to the work, when the balance will be paid, on a certificate by the Trustees' Engineer that the work has been maintained and handed over in a satisfactory manner, and agreeably to the contract.

Arbiter.—In the event of any dispute, question, or difference arising between the Contractor and the Clyde Trustees in relation to this work, the same shall be referred to the amicable decision, final sentence, and decree arbitral of Mr. John Francis Ure, or the Resident Engineer to the Clyde Trustees for the time being, whose award in the premises shall be final and binding on all parties.

Contract.—The Contractor will be required to enter into a regular deed of contract, containing all the usual and necessary clauses, framed on the basis of these conditions, the accompanying specification, and the accepted tender; the expense being borne equally by the Trustees and the Contractor.

Tender.—The Trustees do not bind themselves to accept the lowest or any tender.

SPECIFICATION.—HULL.

General Dimensions.—Extreme length 120 feet. Extreme breadth moulded 33 feet. Height from under side of frames to top of deck-beams amidships 10 feet; rise of deck 9 inches, of floor 2 inches; sheer of deck aft 6 inches, forward 1 foot. Length of bucket-wells, above 76 feet 9″, below $64\frac{1}{2}$ feet; breadth above 4 feet 6 inches, below 4 feet 4 inches. Draft of water 5 feet; centre of upper tumbler above this water-line 21 feet.

Frames.—The frames to be of angle-iron $3'' \times 4'' \times \frac{3}{8}''$, placed 2 feet apart centres; those at the wells to be in one piece from gunwale to gunwale; the others may be in two pieces, shifting joint, however, at least 6 feet, and joined on flitches on each side 18 inches long and rivetted through, or the angle-irons set back to back, and the ends passed 18 inches and well rivetted. The ribs at the bow and stern to be the same size as frames, pitched 2 feet apart at the gunwale, and be returned and rivetted on the nearest floor. The angles of the stern to be double-rivetted on 5-inch angle-iron fixed at lower end on frames; in addition to which the corners are to be secured with two $\frac{3}{8}$-inch plate knees fixed horizontally on angle-iron, and vertical knees 12 inches on the side rivetted on frames and deck-beams there.

Floors.—The whole of the frames to have floors 10 inches deep and $\frac{3}{8}$ inch thick, rivetted on every 4 inches, and stiffened at the top edge with angle-iron $3'' \times 3'' \times \frac{3}{8}''$ rivetted on every 4 inches, and rising 9 inches and 18 inches alternately on frames: this angle-iron to be on each side of those floors under the engine and boilers, and on one side only at the others.

Deck Beams and Carlings.—The deck-beams to be placed some distance apart as frames, and rivetted to them. So far as the wells go, they are to be of T iron 6″ × 4″ × ⅜″; the others to be formed of a plate 8″ × ⅜″, with a bead 1 inch diameter rolled on the lower edge, the upper edge being stiffened with angle-iron 2½″ × 2½″ × $\frac{5}{16}$″, rivetted every 4 inches along both sides of top edge. In both cases the vertical feather to be split up the middle, the lower part of it being curved down the frames, in the case of the smaller beams 12 inches, and of the larger ones 15 inches: the gusset so formed to be filled with a ⅜-inch plate, neatly and solidly welded so as to form a knee, which is to be firmly fixed to frame with four or five rivets.

The engine and boiler hatches to have deck-beams and carlings 8 inches deep, as above described, and on which the hatch-beams are to be turned and double-rivetted; the companion and other hatches to be bridled with carlings same size as deck-beams at the place, and all to have coamings of angle-iron 6″ × 4″ × ½″.

Limbers.—The frames to be bent up for bilge-water passages, and chains laid under the engine and boiler to clean the same when required.

Stem and Apron.—The stem to be 9″ × 2″, and extend from top of knighthead to first floor, on which it is to be fixed with angle-iron corners; angle-iron 5″ × 5″ × ⅜″, to be rivetted through stem, and serve as an apron on which the plating is to be double-rivetted.

Breasthooks.—The bow to be strengthened with two breast-hooks of ⅜″ plates, each about 20 feet long by 18 inches broad at the middle, and 9 inches at the ends: to have 2½″ angle-iron along under side of both edges; that next the skin being firmly rivetted to plating and breast-hook, and the latter notched opposite frames to admit it between them.

Gunwale Iron.—Angle-iron 3″ × 3″ × ⅜″, to extend all round the gunwale of the vessel, including the wells, and be firmly rivetted to frames, outside plates, and deck-beams.

Covering Plate.—The space between the well and outside plating above the deck-beams to have a covering-plate all that breadth ⅜″ thick, and the other portions (forward and aft of well), including across the stern and along insides of wells, to have a covering-plate 12″ × ⅜″: the plates to be joined on butt-straps, double-rivetted, and all to be firmly rivetted to gunwale iron and deck-beams.

Bilge Iron.—The frames at the outer bilges to be rounded to a radius of 18 inches, and those of the inner or well bilges to a radius of 4 inches; outside of the latter an angle-iron 3″ × 3″ × ⅜″ is to run all round, and the side and bottom plating be firmly rivetted to it.

Plating.—The sides, stern, and bottom to be clinker-built, and the wells carvel or flush. The bottom to be $\frac{7}{16}$″ thick; the sides $\frac{5}{16}$″ (except from stem to luff of bow, and the gunwale strake all round, which are to be ⅜-inch); the stern to be ⅜″ thick; the well-sides to be $\frac{5}{16}$″ (except about 15 feet on each side opposite the lower tumblers, where they are to be ⅜-inch); and the ends to be ½-inch. The strakes to be from 27 inches to 30 inches broad; the clinker-work to be *in* and *out* alternately, and have landings 2¼″ broad and single-rivetted; the cross-joints of the clinker-work and all the joints in the well to flush on the outside, and double-rivetted on butt-straps 7 inches broad and same thickness as plates.

The framing and plating of well-sides to be carried into the plumb of upper ends of wells; the end plates to be in one sheet each, curved to the shape shown and double-rivetted on side plating.

The voids between the frames and projecting strakes to be filled with parallel fillings the breadth of the frames, on which the outside plating is to bear hard and fair.

The plates to be generally about 10 feet long; the cross joints to shift not less than 2 feet, and to be as nearly as possible in the middle of the space; where the angle or T iron is but jointed, it is to be fished with plates bent to fit, and 18 inches long. The whole of the outside plating, including bucket-wells, to be flush-rivetted, the outer plates being counter-sunk all their depth to receive batts of rivets; the rivets to range from ⅝ inch to ⅞ inch diameter according to the thickness of the plates, all placed 2¼ inches apart centres, and the double-rivetting reeled. Care is to be taken to make the rivet-holes opposite to each other, but should any not be so they are to be rimmered till this is the case; all the rivets to be of the proper size to fill the hole, both as regards length and diameter.

The landings to be primed with red lead as the work proceeds. The flush joints to be coated with thick red lead, and a strip of canvas about 1 inch broad dipped in same, laid on the seam previous to the butt-strap being rivetted up.

After the rivetting is finished, the joints are to be neatly pared and well caulked on the outside, the ends of the cross-straps inside being also caulked; the edges of the plates at the flush joints outside to be set up before rivetting, and afterwards laid with a hammer. No slips will be allowed to fill up joints between small plates, which must all be fitted quite close; when finished, the whole to look neat and eye-sweet, and be quite water-tight.

Bulkheads.—The vessel to be divided into five divisions by six water-tight bulkheads; they are to be formed of plates ¼ inch thick, having landings 2 inches broad, rivetted together every 2 inches with ½-inch rivets, and every 4 inches to frames of angle-iron 3″ × 3″ × ⅜″ placed 2 feet apart centres; to be well caulked and made water-tight. Man-holes to be formed in the bulkheads, separating the side spaces from engine-room and stoking-room.

Moulding.—A band of coping iron 3″ × 1¼″ to be fitted on the gunwale strake, all round, and flush-rivetted thereto every 12 inches.

Fenders.—A fender to be fixed a little above the water-line, all round the vessel; to be of British oak, 6 inches thick, fixed with ½-inch clinch bolts every 5 feet, through angle-iron 3″ × 3″ × ⅜″ rivetted on plating every 12 inches on either side; this fender to be about 16 inches broad, but more at bow and stern so as to follow the shear. Five fenders to be rivetted on each side of both wells; to be formed of coping iron 2½″ × ½″, trained to a circle swept from centre of upper tumbler shaft; the ends being turned over on bilge iron and deck.

Keelsons and Bearers.—Two keelsons are to run the whole length of the vessel at about 6 feet on each side of the centre line, and there are to be bearers under the main framing, engine, and boilers; these are to be constructed as follows: the two sides are to be formed of plates 12 inches deep and ⅜ inch thick, and the top to be 12 × ⅜″, joined with inside angle-iron 3″ × 3″ × ⅜″, rivetted every 4 inches, and flush-jointed and double-rivetted on butt-straps as before described; the plates to be in long lengths, the joints to shift at least 4 feet all round, and the rivets in keelson to be flush on the outside. The lower edges of both sides to be strengthened with angle-iron 3″ × 3″ × ⅜″, rivetted on every 6 inches, and fastened with four rivets at each floor; to get in this number of rivets where the floors have only 1 angle-iron on top side, a piece of 3-inch angle-iron 15 inches long is to be rivetted on floor under keelson.

The ends of keelsons next the skin of the vessel, or to bulkheads, to have a collar of angle-iron rivetted on, and care taken to make them and any other passages water-tight there, by a diaphragm or otherwise.

Two bearers made of ⅜″ plate and angle iron, and curved to proper shape for carrying the boiler, are to be made to span the keelsons, precautions being taken by introducing slips to prevent the boiler resting on the rivets.

Main Framing.—The main framing for carrying the upper tumbler and other gearing is to rest on the keelsons or bearers above described, and is to be formed of malleable iron, as shown on the drawing; the two central plates to be each 12 inches broad and 5 inches apart, with outside angle-iron 3″ × 3″, on which side plates, 12 inches broad, are to be fixed. All the plates and angle-iron to be $\frac{7}{16}$ inch thick, and the whole rivetted firmly together every 3 inches with snap rivets. The plates to be in one length, those at the curves joining neatly and fair; the rivets at the tops in the wake of dead-eyes or pillow-blocks to be flush; the cross-ties to be carefully fitted, and the whole to be fixed to keelsons and deck-beams, and to each other at the head by box tie beams made in a similar way. The bolt passages to have bosses rivetted in at the proper places.

Shears.—The shears for carrying the lower end of frame to be made and fixed similarly to the above description for main framing, but one-sixth lighter in every respect, except the angle-iron, which is to be $2\frac{3}{4}'' \times 2\frac{3}{4}''$.

Knightheads and Kevels.—There is to be a knighthead at each end of the vessel, composed of oak bollard timbers, through which the hawse-pipes are to be fitted; 14 cast-iron double heads with kevels are to be securely bolted down on covering-board and fitted on top of oak stancheons 5 feet long, which are to be bolted to frames below; the covering-plate to have a collar of 3-inch angle-iron, rivetted on where they pass through.

Butts.—Two cast-iron butts to be fixed down on covering-board at each side of the wells for holding against the bucket-chain when making repairs.

Crab Plates.—The crab winches to have plates, 10 feet long, 12 inches broad, aud $\frac{5}{8}$ inch thick, rivetted to deck-beams under their frames, and four pillars of 2-inch iron palmed at the ends for fixing to beams and floors are to be fixed at each to hold them down.

Coal Bunkers and Stoking-room.—The whole of the bow of the vessel is to be lined with sheet-iron $\frac{1}{8}$ inch thick, fixed on frames with hook-bolts; and carried across well-euds, and fitted up to leave a passage for wheeling coals to the boilers, and at the same time enclose the hoisting barrels from the dust of the stoking-room, a pillar being fitted at each corner, and a door left for access to clean and oil: the floor of the bunker to be saved with larch $1\frac{1}{4}$ inch thick; the floor of the stoking-room and passage to bunkers to be laid with cast-iron plates, chequered on the surface, made to lift if required, but neatly and solidly fitted down; two scuttles to be cut in the deck for coaling, and as many for air; a stair with perforated cast-iron treads to be fitted up to lead from deck to stoking-room floor, and have a framed companion over same.

Store-room.—The floor of the store-room to be laid with timber same as cabin, but noue on the sides or roof; a companion and stair to be also fitted up as above described; rods and hooks fixed for hanging stores on, and lighted from the deck by four dead-lights 12 inches × 6 inches iu brass frames.

Engine-room.—The floor of the engine-room to be laid with timber same as cabin; the house to stand 7 feet above the deck and be composed of bound framing lined and roofed outside with 1-inch boards 4 inches broad, and inside with $\frac{5}{8}$-inch lining, all grooved, tongued, and beaded; the roof to be covered on the outside with strong canvas, nailed on with copper tacks, and painted with six coats of the best white lead; a light cornice to be planted outside and in, and a bound door with brass lock and rollers fitted to slide in grooves at top and bottom; the windows to have sliding mahogany sashes, $2\frac{1}{2}$ feet by 2 feet, made to fasten on the inside, with two panes of $\frac{1}{4}''$ plate glass in each; the framing to be of red pine and the lining of yellow; inside to be painted in imitation of wainscot, and outside four coats of the best oil-paiut; a brass plate engraved No. 6 to be fixed on each side of engine-house, and a stair with cast-iron treads formed to lead from deck to floor.

Flooring.—All the flooring to be of red pine, in boards 6 iuches broad and $1\frac{1}{2}$ inch thick, grooved and tongued, and nailed on straps of red pine, 4 inches × 2 inches, screwed on reverse angle-irons of floors; the planks over the limber passages, bilge-pipes, &c. to be made to unship.

Cabin.—The sides and roof of cabin to be lined with yellow piue, in boards 6 inches broad and 1 inch thick, grooved and tongued, and nailed on straps 4 inches × $1\frac{1}{2}$ bolted to frames or deck-beams, and hollowed at the latter to fit the bead on lower edge of same; the lining to be coved for side lights and knees.

The cabin to have two sky-lights, each 6 feet × 4 feet, with a flat top about 18 inches above the deck, and hinged sashes all round, to open when required for air, and have stout gratings to prevent breakage to same; eight circular side lights, 10 inches diameter, having strong brass opening frames, and thick glass eyes, to be fitted in plating of cabin and officers' rooms, and be water-tight when closed. A hard-wood stair, with brass hand-rail, to be fixed at the cabin-hatch; the companion over it to be well framed, and have a cover sliding in hard-wood guides, and two bound doors with brass lock and hinges, &c. complete: the other companions to be made similar to this one. The main cabin to have 18 folding berths, with plate-iron netted bottoms, hinges, and chains; also 18 cupboards (three in the height), with bound doors, brass hinges, turnbuckles, a shelf in each, and consecutive numbers painted outside; and a meat cupboard with shelves and door. The master's and engineer's room to be divided from the main cabiu by 2-inch bound partitions with bound doors and locks, and ventilated perforations formed near the ceiling; each room to be lighted with two dead lights in deck, and have two folding berths, a desk and two locked presses.

Decks.—The deck planking to be of the best Quebec yellow pine, in long leugths, not more than 6 inches broad and 3 inches thick, except over the side space, where it is to be the thickness of the coveriug-plate less; each plank to be fixed to every deck-beam with two square-headed screws; where resting on iron, it is to be bedded on the best felt of a uniform thickness, and payed with Archangel tar there; all the seams to be dressed square, and have a bevel $\frac{3}{8}$ inch deep and $\frac{1}{16}$ inch broad taken off the upper edges, below which the planks are to bear, and be sufficiently caulked with four small threads of oakum, the first being white and the others brown, all of the best quality, fresh and well teased, and then payed with hot pitch: the decks to be finally dressed flush, and receive two coats of bright varnish. The planks on which the bow and stern crabs are fixed to be of British oak, 15 feet and 21 feet long respectively, by 12 inches × $3\frac{1}{2}$; those at the well-sides being also of British oak, and 9 inches × $3\frac{1}{2}$; the planks to butt joint neatly over a deck-beam, and where pierced for machinery, &c. made so that no water will pass through.

Water-ways.—The water-ways to be of red pine, 12 iuches broad and 5 inches thick, hollowed to thickness of deck for water-runs to scuppers, of which there are to be four at each side; they are to be in long lengths, scarfed and bolted at the joiniugs, and clinch-bolted at every frame to gunwale strake and covering-plate alternately, and caulked tight.

Covering Board.—The covering-board shall be of British oak, 12 inches broad and $2\frac{1}{2}$ inches thick, fastened to water-ways with 5-inch spikes 15 inches apart, and to timber-heads aud stancheons with clinch-bolts; it is to be rounded on the outside and saved there with $\frac{5}{8}$-inch spout-iron, fixed every 8 inches with countersunk rag-bolts, 4 inches long; the joints to butt close aud have two bolts there.

The water-ways, covering-board, and spout-iron, to go also across stern, care being taken to keep the joiuts of the spout-iron and moulding away from the corners of it.

Rail.—The rail to be of American rock elm, 6 inches × 3 inches, rounded on top, and beaded on lower edges, aud morticed on British oak stancheons, 6 feet loug, sided $5\frac{1}{2}$ inches and moulded $3\frac{1}{2}$ inches, and placed 6 feet apart; the lower ends being firmly fixed on frames below deck.

Boiler Coamings.—An angle-iron coaming to be fixed round the boiler-hatch, and have a lead apron dressed to it.

Water-closet.—A water-closet, enclosed in a framed house, to be erected on deck at after-end of oue of the wells, and have a soil-pipe leading into water from same.

Galley.—A framed galley to be erected in a convenient position on deck, made so that it may be shifted if required, but lashed to deck with ring-bolts; the floor, funnel-port, and timber opposite cambouses, to be lined with lead to prevent fire.

Steps.—Angle-iron treads to be rivetted on each side of the vessel at shoots, to facilitate access to deck of vessel from punts.

Quality of Materials, Painting, &c.—The whole of the plating, angle, or **T** iron, aud rivets, to be of the best quality of Govan **B B** iron, or other equally good material, approved of by the Eugineer; any difficult bends being made of Bowling or Low Moor iron.

The plates to be properly cleaned before use, kept dry, and quite free of oxidation when being painted.

The frames, floors, and deck-beams, to be pierced where required for lining, straps, &c.

The whole of the iron-work to receive two coats of red lead, and three of good oil-paint, finishing with a brown body aud red moulding.

The whole of the timber to be dressed, and receive four coats of the best oil-paint after being primed; no large or loose knots, sapwood, shakes, or other imperfections, will be allowed in any part of the work.

So soon as the Contractor's tender is accepted, he will be required to cut a sufficient quantity of the various scantlings of timber required, and stack the same under an open shed, so that it may be thoroughly seasoned when it is used.

MACHINERY.—ENGINE.

The motive power to be a condensing side lever marine steam-engine, nominally of 40-horse power, the cylinder being 37 inches diameter, and adapted for a 3-feet stroke. The sole-plate to have a peined condenser cast on it, also a facit for air-pump, passage for foot-valve between these, pillow-blocks for main centres, and sockets for framing; to be bedded on an oak plank and bolted firmly to engine-bearers. The frame, entablature, and diagonal ties to be of cast-iron, the latter fitted and bolted to cylinder, and all bored to receive upper end of malleable iron pillars $4\frac{1}{2}$ inches diameter, the lower ends of which are to be keyed through bored sockets in sole-plate; the entablature to be screwed down over all. The nozzles to be cast on the cylinder, and have a short 3-port bridged valve, with a lap of three-quarters of an inch. The steam-piston to have metallic packing in one depth, and of an approved construction. The cylinder to have two spring priming valves; a grease-cock on the cover; a $\frac{3}{4}$-inch drip-cock on bottom of nozzle casing, and a blow-through valve. The piston-rod to be guided by a crank parallel motion. A bilge injection-cock to be fitted on the condenser, in addition to the sea one. The air-pump to be of solid brass not less than $\frac{3}{4}$ inch thick when finished, be one-fourth the capacity of the steam-cylinder, and have the bucket and valve of brass, with which metal the pump-rod is to be cased. The discharge and foot valves, with their facings, to be of brass, and to be made easy of access. The hot-well to be as large as the air-pump, have a tight cover, and copper air escape pipe. The bilge and force pumps to be worked off the air-pump cross-head, and have ram-plungers cased with brass. A 2-inch lead bilge-pipe to lead from each division of the vessel into a chest in the engine-room connected with the pumps; cocks to be fitted on the chest for each of the pipes, the far ends having bends and roses fixed on the bulkheads: the keys of the cocks are to be connected with a series of handles fitted on an engraved plate near starting platform, so that any division may be pumped out without the engineer going below. The steam-pipe to be 7 inches diameter, be covered with felt, and served with canvas: it, as well as the other pipes connected with the engine, unless otherwise specified, are to be of well-hammered sheet copper $\frac{1}{5}$ inch thick, joined with brass flanges and vulcanised India-rubber rings and screws. The feed-pipes to have valves in the boilers, and cocks are to be fitted on them between boiler and waste-pipe, the latter of which is to have a valve loaded to exceed the working pressure. Each side lever to be composed of two malleable iron plates, $\frac{7}{8}$ inch thick, joined with centres and studs firmly rivetted together, and keyed on a main centre of malleable iron, 7 inches diameter, oscillating in double brass bushes. A 6-inch brass force-pump to be attached to a convenient part of the engine, with air-chamber, and copper pipes leading therefrom to upper ends of shoots, the water being drawn from the hot-well, where there is to be a cock, to open at pleasure; the pump to be made so that it can be disengaged or attached with facility.

A conical pendulum governor of the best construction, to be driven by adjusting buff-wheels, so as to regulate the engine to 32 strokes per minute. The crank to be 18 inches long at centres, and forged from the best scrap. The crank-shafts to be 7 inches diameter at the journals, and 8 inches at the body, which is to be turned throughout with a slight taper, and have a keying-groove slotted in it. The engine to have two fly-wheels, cast in segments, fitted and bolted to arms fixed to the centres, which are to be bored and fixed on shafts with keys and feathers. The eccentric strap to be of brass. The connecting-rod, cross-heads, and cross-tail to be all of malleable iron, and finished of an approved shape. The journals to work in double brasses, and the collars of stuffing-boxes to be of brass, with which metal the covers are to be bushed all the depth. The engines to be finished "bright," well fitted and proportioned, the parts not polished being painted with copal green A brass rail 2 inches diameter, with pillars and bosses where required, to be fitted up to guard the starting platform, &c.

The Trustees reserve power to order a low-pressure double-cylinder steam-engine in place of the one described above, in which case the larger cylinder is to be 45 inches diameter, and adapted for a 3-feet stroke, and the smaller cylinder to have four-tenths of the capacity of the other. To be a lever-engine, and otherwise similar in parts and finish to the one above specified.

The following instruments to be placed in a convenient position in the engine-room, viz.: water-gauge, mercurial steam-pressure and vacuum gauges; a counter to indicate the number of strokes, and another connected with a well-made strong spring-clock and with the engine, to show the actual time the latter is working.

BOILERS.

The steam to be generated in two cylindrical boilers, each 15 feet long and 6 feet diameter, with return-flues rising into steam-chests 2 feet above deck, one end of each boiler being made hemispherical and the other flat; both boilers to have two furnaces, each 2 feet wide and 5 feet long, with cast-iron bars $\frac{5}{8}''$ thick and $\frac{3}{8}''$ draft spaces between, the outer end to rest on a 3″ angle-iron across the mouth of furnace, and the inner end on the shelf of a cast-iron chair, also supporting the fire-brick bridge-wall; this chair to have a double back, and valve with adjusting-rod to regulate the admission of air for consuming the smoke. An angle-iron to be rivetted round the steam-chest at the level of the deck, to make good the connexion between the boilers and deck.

The whole of the plates to be $\frac{3}{8}$ inch thick, with 25-inch landings and $\frac{11}{16}''$ rivets $2\frac{1}{4}$ inches apart centres, all well caulked. The plates in furnaces and flues to be of Low Moor iron, and the rest equal to the best Monkland or Govan; the plates for furnaces and ash-pits to be in one length each, and have the batts of the rivets outside; the boilers to be properly stayed with screw-bolts and bosses; the furnace-doors and their dampers to be $\frac{1}{2}''$ plate, and fitted with hinges and catches. Each boiler to have a sludge and man-hole with doors and fixings; a $2\frac{1}{2}''$ blow-off cock fixed to bottom plating and connected to the boiler with a copper pipe, 6 feet long and $\frac{1}{8}''$ thick, and a brass plate with gauge-cocks and glass tube; the waste steam-pipe to be made of hammered copper, $\frac{1}{16}''$ thick and 6″ diameter, be 20 feet long, have a thistle head, and be fitted on the waste steam-chest; this is to be provided with two direct-action safety-valves, 5 inches diameter, having the seats, valves, and rods of brass: the first weight to represent 4 lbs. on the square inch, and be inside the covers; each of the six others to be the same diameter, but represent 1 lb. on the square inch, and made to rest on a ruff on the upper end of spindle. The waste steam-chest to be bolted to the roof of steam-dome, and have a small copper pipe for running off the waste steam which may condense there into the well.

The boilers and steam-chest to be covered with hair-felt 1 inch thick, kept on with a sheeting of No. 1 canvas neatly fitted and painted.

A steam-whistle to be fixed on a brass tube 20 feet high, so as to give the alarm when the water in the boiler is within 2° of the crown of the flues; it is to be fixed alongside of the waste steam-pipe by brass collars cast on the rings with which the waste steam-pipe is fixed to the funnel. The whistle is also to have a branch pipe from the steam-chest, to blow it when required, two cocks being fitted on for this purpose.

The funnel to be 21 feet high and 32 inches diameter, made from plates $\frac{1}{8}''$ thick, butt-jointed and flush-rivetted throughout; the inside vertical straps to be in one length $3'' \times \frac{1}{4}''$, and the horizontal joints covered outside with funnel-iron; to be provided with a damper and rack, sliding door, crance, and pulley, and four chain-stays with tightening screws made fast to upper ends of malleable iron pillars fixed in sockets on deck, and all painted black.

The boilers to be proven steam-tight, under a pressure of 15 lbs. on the square inch, by raising the steam before they are removed from the works; and they are to be fitted so that they may be worked separately.

(To be continued.)

NOTES BY A PRACTICAL CHEMIST.

SUBSTITUTES FOR TARTARIC ACID.—The high price of tartaric acid consequent upon the grape-blight renders a substitute of great importance to dyers and calico-printers. The substance must be able to decompose chloride of lime, setting free chlorine, and to dissolve the mordants by which the colour is fixed. It must be readily soluble, not apt to attack the fibres or corrode the metal of the plates, nor must it injure the permanent activity of the chlorine-vat. Arsenic acid would be admirably fitted for this purpose, did it not seriously injure the hands of the operators. (Might not a thin glove of caoutchouc, such as is used by dissectors, act as a safeguard?) Phosphoric acid, recommended by Bolley, is expensive. Perchloride of tin, containing a certain amount of free acid, may be used, but requires great caution. Bolley has employed samples not quite free from acid, and containing 36 per cent. of tin; 11 parts of it replace 10 parts of tartaric acid, and in price it is between half and three-fifths that of the latter. The solution, though it does not attack the rollers and the brass of the dot-patterns, acts upon the alloy of lead, tin, and bismuth, of which perrotines are composed. The fibres are uninjured, but the whites have a yellowish tinge. The muriatic acid of the perchloride also gradually increases the amount of chloride of calcium in the vat, and may induce errors if the strength of the chlorine-vat be tested with the hydrometer. But if Crum's method be used for determining the chlorine, this objection is got rid of.

Lactic acid would be of the greatest use, if it could be prepared rapidly and cheaply. Oxalic acid, from its sparing solubility, is inapplicable, except it can be dissolved more abundantly in some saline solution than in water. Nitro-saccharic acid might possibly answer, and we recommend chemical manufacturers to turn their attention to the economical preparation of this substance.

PRICE'S NEW METHOD OF ALKALIMETRY.—Mr. James Higgins points out a source of error in this process, arising from the circumstance that oxalic acid decomposes chloride of sodium, forming quadroxalate of soda, whilst muriatic acid is expelled by the boiling. "Thus, in case of a commercial soda ash which always contains chloride of sodium, more oxalic acid will have been consumed than would neutralise the carbonate, and the amount of soda is estimated too high."

SUBSTITUTES FOR CITRIC AND TARTARIC ACIDS, AND THEIR SALTS.—Gatty and Kopp employ lactic acid and the lactates. This acid, when used as a resist, is thickened with starch, and then printed by block or roller upon cloth, which is afterwards printed or padded with mordants. One gallon lactic acid at 40° Twaddle is used, instead of one gallon lemon-juice at 50° Twaddle. In cases where the lemon-juice is previously saturated with an alkali, the lactic acid is treated in the same manner.

When lactic acid is used as a discharge, it is thickened as in the above case, and printed upon cloth saturated with mordants, which it discharges by forming soluble salts with the oxides constituting the mordants. In using lactic acid to precipitate carthamine from the alkaline solution of safflower, 4 lbs. acid at about 40° Twaddle are used in place of 3 lbs. tartaric acid. In dyeing Prusian blue, scarlet, crimson, &c., on silk or wool, tartaric acid or cream of tartar is generally used. In such cases, lactic acid or bilactate of soda is applied, and the manipulations are the same as when tartaric acid is used, 1¼ lbs. bilactate of soda at 66° Twaddle serving for 1 lb. cream of tartar. When lactic acid is employed for steam colours, it is substituted for tartaric acid in the proportions already stated, the preparation of the colours being the same as when tartaric acid is used. Lactic acid may be applied in preparing white and coloured discharges upon Turkey red and other colours; the operation is managed just as if tartaric acid were used—only, after printing, the cloth should not be exposed to a long-continued heat, which, owing to a slight volatilisation of the lactic acid, would reduce its discharging properties.

Bellford's process depends upon the formation of an artificial tartaric acid by mixing oxalic acid with sugar, a substance containing the exact proportion of hydrogen in which oxalic acid is deficient. A quantity of sugar or treacle is drenched with nitric acid, and with some mother-water in which oxalic acid has been crystallised. As soon as nitrous vapours cease ascending, more nitric acid is added, and the solution is then concentrated until a crystalline mass is obtained on cooling. This mass consists of slender crystalline needles, and is next washed for obtaining the acid. After washing the crystals, add sugar which has been dissolved in some of the washing liquor, the quantity of sugar required being proportional to the degree of acidity which it is desired to attain. The syrupy fluid is then concentrated at a gentle heat, and left to crystallise at a moderate temperature. Or, take one part of sugar or treacle, and add one-third acetic acid, and three parts nitric acid at 36° Twaddle. This yields an oxalic acid containing more hydrogen than the common oxalic acid (? !) The crystals obtained from this solution are purified by washing and re-crystallisation. The oxalic acid thus obtained may be converted into tartaric acid by deoxidisation. This is effected by dissolving sugar in the washing liquor and mixing with the acid. The solutions, when concentrated at a low temperature and crystallised, yield so-called "tartaric" acid. The wash liquors when concentrated may be used as mordants.

Murdock substitutes for cream of tartar, and for the mixture of cream of tartar with alum, common salt with nitric acid, and sulphate of alumina. 100 lbs. salt are mixed with 300 lbs. of water; and when dissolved, 20 lbs. nitric acid are introduced. When alum is required, 100 lbs. sulphate of alumina are gradually added. The water should be cold, and the mixture but slightly stirred.

ANSWERS TO CORRESPONDENTS.

"J. C., Gateshead."—Compounds of the fatty acids with alkalies are named *soaps*; those with heavy metallic oxides, such as iron, lead, &c., are *plasters*.

"H. Horner."—To detect mineral matter in chocolate, burn the sample to ashes in a thin porcelain crucible, and treat the residue with strong muriatic acid. If any portion remains undissolved, it will be silica. Test a portion of the clear liquid for lead with chromate of potash and sulphuretted hydrogen. Examine another for iron with sulphocyanide of potassium and tincture of galls. A part of the original ash should be heated on platinum wire before the blow-pipe, moistened with nitrate of cobalt, and again heated. If it turn blue, clay was present.

AGRICULTURAL ENGINEERING.

ROAD AND LAND DRAINAGE.

(Continued from page 275.)

Mr. Spooner says that drainage is ordinarily expected to yield not less than 10 per cent.—in some instances even higher; and even more than 25 per cent. has been realised. Mr. Maccaw states that the ordinary expectations are from 8 to 10 per cent. The returns are generally calculated from results actually realised out of lands already drained, of similar character to that intended for improvement by drainage—viz., by ascertaining the value of the land in yearly rent previous to drainage, and its subsequent value realised after drainage and cultivation; and as illustrations, he gives the following interesting cases:—

Nos.	Character of soil.	Original annual value.	Cost of drainage.	Present annual value.	Increased annual value.	Rate per cent. realised from outlay on drainage.	Remarks.
		s. d.		s. d.	s. d.	Per cent.	
1	Deep-soil; a part mossy.	15 0	Outfall £3 4 5 Drainage £6 16 1 Total £10 13 6	60 0	25 0	12½	This piece of land consisting of lochs, water-meadow of little value. Expensive outfall.
2	Loamy soil; springs existed.	20 0	£7 7 4	32 0	12 0	8¼	Drained 4 feet deep. Land long under cultivation.
3	Thin clay soil; stiff subsoil.	12 0	6 6 0	30 0	18 0	13¼	Drained in 1843. Afterwards a 5 years' rotation in cropping.
4	A weak thin soil, gravelly with clay.	20 0	5 10 0	36 0	16 0	14¾	Drained in 1845—near a town. Drains 36 feet apart, 3½ deep. Crops sold by auction.
5	Mossy soil.	2 6	Draining and Trenching £8 0 0	14 0	11 6	7⅛	Mossy surface, clay and gravel subsoil. High climate.

The actual results obtained from No. 3, after being drained, in a rotation of crops—1st year, potatoes; 2nd, wheat; 3rd, hay; 4th, pasture; 5th, oats £49 0 0
On which expended, on drainage, subsoil-ploughing, ordinary cultivation, rent, and all charges for five years 36 5 6

Balance of profits in five years £12 14 6

Being at the rate of £2 10s. 10d. per acre annually. This was on land where green crops could not be raised, and on which the crop of oats, preceding drainage (1843), did not yield more by public sale than an average of £2 5s. per acre.

No. 4 was drained in 1845: three crops have since been disposed of by public sale, realising £32 0 0
Expenses of drainage, cultivation, rent, manures, &c. 21 0 0

Profit £11 0 0

Being at the rate of £3 13s. 4d. annual profit.

In the case of a marsh drained on the same farm, the outfall costing at the rate of £2 10s. per acre—trenching £6, drainage £4 10s., rent 5s., planting, potatoes, seed, manure—total cost £22 10 0
£25 per acre was refused for the crop, which became afterwards slightly diseased, but sold for 22 0 0

Thus proving one crop to have paid for all except £0 10 0

"These," says Mr. Maccaw, "are, however, favourable cases, from the superior cultivation and manuring over that generally given to land where drainage has been effected; and from the favourable nature of the seasons, and high rates received for crops, sold almost without any failure. Calculations of drainage returns cannot altogether be based on such favourable cases: great allowances require to be made. However, I could instance several farms which, after drainage and high cultivation, now keep more than double their former stocks of cattle, and even exceed that in their increased grain-crops. Indeed, I know few cases, under the worst circumstances, where thorough-drainage has been efficiently executed, that the parties concerned have not been satisfied of its beneficial results."

Mr. Beattie says that the results are from 10 to 20 per cent. on rich soils. Under good agriculture, from 30 to 50 per cent. has been satisfactorily shown as the results obtained. The expense of cultivating wet lands is frequently double that of dry, while the returns are inferior in quantity and quality. Mr. Scott states that the actual results of his experience have been from 10 to 20 per cent. Mr. Neilson says that his experience and observation have been chiefly on heavy clay-soils, where the result of drainage is eminently beneficial, and where, taking quality and quantity into consideration, he estimates the increased crop at 6 to 10 bushels per statute acre. He estimates also, that, from the increased facilities for working on drained land, a farm of 220 acres, on the four-course system, can be cultivated with one pair of horses, and appurtenances less than would be necessary if the land were undrained.

But not only does drainage improve the productive powers of the land for the cultivation of any crop adapted for it, but it enables crops to be grown where formerly they could not be cultivated. "The whole of the heavy alluvial clay of the carses of Scotland," says Mr. Smith, "on which potatoes were seldom grown successfully, and turnips never, now carry freely heavy crops of both, more especially turnips, which are followed by excellent crops of wheat." "Large breadths of land," says Mr. Parkes, "previously unable to carry wheat, have been rendered capable of producing superior crops. Land also, which in its natural state is too weak for the growth of turnips, is commonly qualified, by good drainage, to produce that crop in perfection. The turnip system is, on many soils, the only sure preparation for grain crops, and, generally speaking, it is the secret of profitable husbandry." "On my own farm," says Mr. Scott, "at West-side House, near Staindrop, I grow wheat, barley, and turnips upon lands that were incapable of growing those crops previous to draining." "A portion," says Mr. Neilson, "of my present farm, which is of stiff clay, lies low and level. Previous to drainage, the waters of winter seldom disappeared before the heat of summer had opened a passage by cracking the land. My predecessor had endeavoured to get a green crop, but always failed. The crop, the year previous to my taking it, did not produce above 3 tons of turnips to the acre, in consequence of the inefficiency of the manure from the stagnant water. I drained it the following winter, and the summer after I obtained 27 tons of turnips per acre off the whole field."

With reference to the points—1st, The effects extensive drainage had on the main watercourses of a district; and, 2nd, Whether any important applications have been made of additional water-streams thus derived—there are some interesting notes given in the Report. Space only allows us to notice briefly the extensive application of drainage-water on the estate of Lord Hatherdon, in Staffordshire. Several ponds are used for storing it: carried to his farmyard, it is there employed to drive a water-wheel which does all the threshing, &c., in addition to driving a saw-mill. After thus working, it is passed to meadows on a lower level, where it is used in extensive and profitable irrigation. "Drain-water always contains more or less of the manure and soluble parts of the soil in suspension, and the fertilising properties of the drain-water on this estate (Hatherdon) are particularly marked by the very luxuriant growth of grass it produces on the meadows." "I have long been of opinion," continues Mr. Smith, "that it would be found profitable to have a large pond at the lowest point of every farm to receive and store the water from the drains, and to have a steam-engine to pump and convey it in pipes for watering the fields during dry periods. By this means the crops would be much refreshed, and whatever matter had been taken off the land by the drain-water would in great part be returned." As corroborative of this opinion, we might cite the evidence given in the Report, in answer to the question, "Are there any cases known where observations have been made as to the quality of the water derived from drainage—that is, as to its temperature, clearness, and as to the salts or vegetable and animal products that it contains—with a view either of determining its fitness for domestic or other uses, or for finding to what extent it has carried down matters from the soil?"—but space only permits us to append the following analysis of drain-water from a farm in East Lothian, by Mr. John Wilson:—

Analysis No. 1.

The water taken from the drains upon the 29th April, 1844, when there had been a moderate fall of rain. The land was in plough as winter fallow. Eighteen pounds of drainage-water, on the evaporation, gave 15·2 grains of solid residue, or about ·844 grains to the pound.

Organic matter and water in combination	3·04
Silica	0·09
Silicate of alumina	0·04
Chloride of magnesium	1·12
Chloride of sodium	0·08
Chloride of calcium	3·00
Sulphate of alumina	0·85
Peroxide of iron	2·01
Phosphate of lime	0·03
	13·87

With reference to this point, Mr. Parkes says that the analysis ot drainage-water "pre-eminently deserves attention in an agricultural point of view." He adds, moreover, that the temperature is of the "highest import, as thermometric observations may be rendered demonstrative in the truest manner of the effect of drainage on the climate of the soil." The result of his observations, however, shows that drainage has a beneficial effect in raising the temperature of the terrestrial climate during the summer months; and he calls this the "all-important fact connected with the art and science of drainage." Mr. Maccaw says that he has no "doubt that by the process of thorough deep-drainage, a considerable portion of valuable fertilising matters may be extracted with water from the lands, but *not a tithe* of what would be carried off by water from the same soil previous to drainage."

We now hasten to the evidence given on the important points connected with the practice of drainage—1st, The depths and distances; 2nd, The materials employed; and, 3rd, The cost of constructing drains.

With reference to the disputed points, as to the depth and distances of drains, much interesting information is given by our authorities, of high practical status, in answer to the question—"Will you state generally the depths and distances of the drains that are in use in relation to the different descriptions of soil, and what is the amount of the discrepancy; and whether this is accidental or ruled by district usages, or by the opinion of different engineers ?"

Under the same head, Mr. Spooner (of Balmacara House, Lochalsh) has some interesting and valuable information. He says it is easy to discover the origin of the rules for DISTANCES, by looking back to that of parallel drainage. Prior to the practice of the under-drainage, strong and wet lands were rendered capable of arable culture by being ploughed up into the waving shape termed "ridge-and-furrow"—the bottom of the furrow forming the drain for the ridge. In consequence, however, of the crops perishing in and by the sides of the furrows (or thoroughs), the water was drawn off from them, by having shallow drains below each, and kept open by straw or brushwood. This was termed furrow or thorough draining. It is thus that the distances of the furrows from each other indicate the distances of the drains in any particular district. And the distances now most commonly in use in different districts, and on the different sorts of soils, have all reference to a width of ridge that either formerly was, or now is, in use in those districts. Mr. Spooner, in connexion with this point, directs attention to a fact worthy of notice —namely, that throughout the country the statements of the number of feet from drain to drain is in almost every instance divisible (when reduced to inches) by eighteen; that being the space of ground, in inches, moved by a single turn of ordinary ploughing. Mr. Spooner is particular in mentioning this fact, inasmuch as he considers that long-established usages of a particular district indicate the requirements of that district, and that the distance from furrow to furrow points out to a considerable extent the tenacity or porosity of the soil, or its capacity of retaining water on the one hand, and transmitting it on the other. He further states, that he conceives the differences in opinion existing among practical men on drainage to have arisen in a great measure from a want of a due observance of these differences, and also from the too frequent attempt to establish rules of general application founded on the successful practice of some one locality.

Mr. Spooner also gives some evidence as to the depths of drains. Since the notion that water in or near the surface of strong clay-soils could not descend to deep drains has been exploded, the formation of deeper drains than those formerly used for clay-soils has become very common, and with them others of a lighter description—the difference being represented by that which exists between 18 to 30 inches in one case, and 36 to 48 in the other. The question of "depth" is affected by two considerations—permanency and efficiency. In most soils shallow drains become rapidly choked, by being filled up with fine particles washed down through the cavities, occasioned by tillage: deep drains, being further removed from what may be called the "zone of active tillage," remain longer efficient. That deep drainage is more efficient than shallow is best proved by the rapid extension of the system, even in cases where the utmost amount of good has been previously obtained by shallow draining, so far as it was capable of effecting good. Mr. Spooner thinks that, in the generality of soils, drains are not safe under a depth of 3 feet, and that a greater advantage may be obtained by laying them from that depth up to 4 feet. He says, however, that he does not think there is evidence to prove that depths greater than this give advantages commensurate with the increased expense. He also is of opinion that, speaking in general terms, it is to the suitable distance apart of drains that efficacy is to be looked for, and permanency to their depths.

With reference to the "materials" used for drains, there are some interesting details: all, however, point to the cylindrical drain-tube as the best. Stone drains are apt, in sandy and loose soils, to become silted up by the sand entering with the small streams, the action of the water not being strong enough to carry away the deposit. Tubes made of peat-earth are sometimes used, and have been well received by agriculturists. The two principal materials used, however, are the "tiles" and "pipes." The latter seem to be in every respect preferable to the former: all authorities agree in stating that they discharge the water quicker. Mr. Maccaw gives a most decided opinion in favour of pipes, especially when socketed into one another. For this preference he gives four reasons:—1st, That pipes require less material, have greater strength with less weight, and will discharge the water quicker. 2nd, The water in the tube will carry all deposit of soil quicker to its destination. 3rd, From the way in which the tiles lie upon the soles, the greatest quantity of drainage enters between these, not at their vertical joints, thus presenting too much orifice for allowing earthy deposit to enter. Pipes do not admit this, and when laid with collars or sockets, little sediment can enter, or roots, &c. 4th, The weight of pipes being less than that of tiles, the cartage will be less expensive; and generally the pipes are cheaper than the tiles.

In the body of the Report some very valuable suggestions are given as to the placing of the drain-tubes. Among other points, they draw particular attention to the absurdity of making junctions at right angles, a practice too common in land-drains. This positively impedes the flow. Thus, it has been ascertained that where the resistance due to a junction at right angles was 316, that due to a curved junction of 5 feet radius was 146, while that for a curved junction of 20 feet radius was only 100; thus showing the increase of resistance to be 200 per cent. over the junction of 20 feet radius.

Fig. 7.

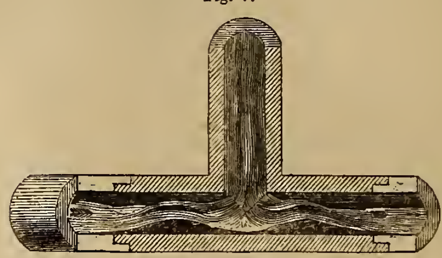


Fig. 7 shows the effect of the splashing of water in which a deposit is contained, with a junction at right angles. Attention should be paid to the manner in which the curved junctions should be laid down. Thus, it is too frequently the way to join the curve to the pipe by a hole placed in the middle of the periphery of the latter, as in Fig. 8, in place of level with the bottom, or bell-mouthed, as in Fig. 9. These illustrations are derived from another report on drainage, and although illustrative of town-drainage, the advantages obtainable by their use are as valuable in land-drainage.

The smaller the amount of water to be discharged, the greater ought to be the care in the construction of pipes, or the channel of conveyance. In some trials with drain-pipes, it was found that with pipes of the same

Fig. 8.

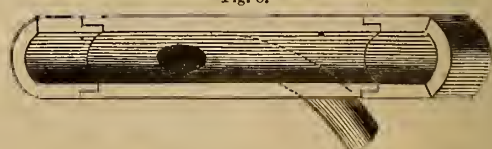
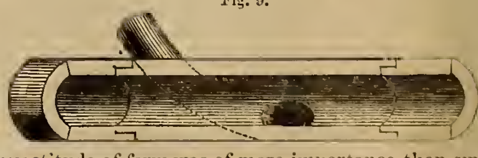


Fig. 9.



diameter, exactitude of form was of more importance than smoothness of surface—that glass pipes of a wavy surface discharged less water than Staffordshire pipes of exact form. By passing pipes of common red clay under a second pressure, obtained by a machine at an extra expense of 1s. 6d. the 1,000, whilst the pipe was half dry, very superior exactitude of form was obtained: with nearly the same diameter, an increased discharge of one-fourth was effected in the same time.

As regards the size of drain-pipes, the conclusions of trials indicated that it might be expedient to make land-drainage pipes yet smaller, improving their manufacture, making them more exact in form, and laying them more carefully. We may at a future time present a few notes on the important point of flow of water through tubes; but we now hasten to the concluding point of our "Minutes"—the question of the "cost" of drains.

As to the cost of drainage, Mr. Spooner has some interesting and valuable information. The cost of drainage is principally dependent upon the labour of cutting and filling the drains, the material composing the drain and outlet for discharge. This last varies with the nature of the ground, and can only be included in a general estimate where the surface gently undulates. It was formerly held that the cost of drainage was equally divided between the labour and material: this holds where, in 2½ or 3 feet drains, stones are used, or horse-shoe tiles on soles. With pipes, and the improvements in making them, there is a considerable balance in favour of material—the labour being increased, however, by the increase of depth.

Fig. 10.

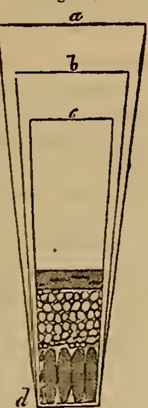
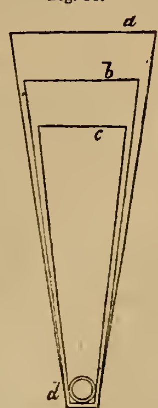


Fig. 11.



The item for labour can be determined with sufficient accuracy by referring it to the standard of the "value of moving a solid yard of earth of any one description of hardness." In illustration of this, Mr. Spooner has drawn up the following table, which supposes two sets of drains—one opened for stones, the other for tiles—the depths assumed being 3, 3½, and 4 feet. The average width of cutting for each size and sort, the number of lineal yards required to equal a solid yard, are displayed in the table—assuming three descriptions of soil—the differences in hardness of which make the cost of moving their solid yard 4d., 6d., and 8d., respectively. The labour-value per yard, and per rod linear, of the different depths and sorts, has also been calculated. It is a common remark, that the cost of making drains is doubled for every foot of increased depth given, and the same proportion for every part of such increase: this is also given in the table.

In fig. 10 we give a diagram of the "stone drains," the three depths being 4 feet, 3½, and 3 feet; the width at top of *a* being 18 inches, of *b* 16 inches, and *c* 12 inches; the width, *d*, at bottom being 8 inches. In fig. 11 we give the diagram for the "pipe-tile drains," the three depths being 4, 3½, and 3 feet; the width of *a* being 18 inches, *b* 16, and *c* 12 inches; the width, *d*, at bottom being 3 inches.

Average width of back drain.	Running yards of drain to the cubic yard.	Sandy soils, light loams, and light clays—easy diggings.		Stiffer clays and gravel, requiring some pickwork.		Hard clay and close soils, requiring pickwork before they can be done.	
		At 4d. per cubic yard.		At 6d. per cubic yard.		At 8d. per cubic yard.	
		Per yard.	Per rod.	Per yard.	Per rod.	Per yard.	Per rod.
STONE DRAINS.							
14	2+	2d.	11d.	3d.	1s. 4½d.	4d.	1s. 10d.
12	2½—	1⅗d.	9d.	2⅖d.	1s. 1¼d.	3⅕d.	1s. 5½d.
10	3½+	$1\frac{1}{7}$d.	6½d.	$1\frac{5}{7}$d.	8½d.	2½d.	1s. 0½d.
PIPE-TILE DRAINS.							
10½	2½+	1⅗d.	9d.	2⅖d.	1s. 1¼d.	3⅕d.	1s. 5½d.
9½	3¼	$1\frac{3}{13}$d.	7d.	$1\frac{11}{13}$d.	10¼d.	$2\frac{6}{13}$d.	1s. 2d.
7½	$5\frac{1}{13}$	0¾d.	4¼d.	1⅕d.	6½d.	1½d.	8¼d.

The + and — attached to the figures in the second column imply a small fraction, greater or less, than the number stated. In the price per rod, the fractional parts are reduced to the farthings nearest to them.

From the table it may be seen, by inspection, that the cost of cutting a stone drain of 3½ feet deep may cost 9d., 1s. 1¼d., or 1s. 5½d. per rod, according to the hardness or otherwise of the soil. For pipes, the cost would, under the same circumstances, be either 7d., 10¼d., or 1s. 2d. per rod. So also a pipe-drain, in one description of soil, may cost in labour but 4¼d. per rod; in another description 8¼d. per rod; and the same, if for stone, 1s. 0½d. per rod. Having ascertained the number of rods and tiles required per acre, the drains at any given distance, the cost may be easily ascertained as follows:—Suppose the soil to be of class No. 2, the drains 24 feet apart, 3 feet deep, pipes 1⅝ inch in the bore—

110 rods of drains, at 6½d. per rod		£2 19 7	
1,185 pipes, 12 inches long, 1⅝-inch bore, at 21s. per 1,000		1 18 2½	
Cost per acre		£4 17 9½	

Example 2nd.—Soil, class No. 3, laid with horse-shoe tiles in flat soles.

110 rods of drains, at 8¼d. per rod		£3 15 7½
1,185 2 by 2½ inch tiles, 12 inches long, at 25s. per 1,000	£2 5 4	
1,185 flat soles, at 16s. 6d. per 1,000 ..	1 9 11½	
		3 15 3½
Cost per acre		£7 10 11

In both these cases, Mr. Spooner has not included extra estimates for leaders, and for the larger-sized tiles required for them, inasmuch as when the tract of land to be drained is of large extent, he finds that the estimated quantity of the other pipes exceeds the actual quantity used, and that the extra expenditure for leaders is thus generally covered.

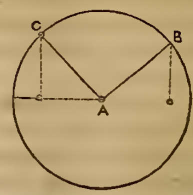
NOTES ON THE PROGRESS OF ENGINEERING, &c.

Liverpool, December, 1854.

Liverpool, possessing such well-known and excellent establishments as Laird's shipbuilding yards, the Mersey Steel and Iron Company's works, the foundries of Messrs. Fawcett and Preston, and Messrs. Forrester and Co., &c., at a time such as the present is not likely to be behindhand in furnishing ships, guns, or any other kind of offensive or defensive heavy hardware, if called upon. The "trial-trips" of the steamers are recorded almost weekly in the local papers; and some of the larger ones made there will be generally known to the public by the fact of their being taken up by Government as transports—for instance, the *Nubia*, a fast and fine screw-steamer, made for the Peninsular and Oriental Company by Laird, fitted with geared oscillators, cylinders 78 in., stroke 5 ft., by Fawcett and Preston; also the *Bahiana*, the *Imperatrix* and *Imperador*, &c. The *Bahiana* is of 1,700 tons burthen, and fitted with geared oscillators similar in design to the *Great Britain's* and *Nubia's*, with 54-in. cylinders and 4-ft. stroke. The *Imperador* and *Imperatrix* have angled engines, direct to the screw, with 54-in. cylinders and 2 ft. 9 in. stroke. Messrs. Fawcett, the makers of them, have combined the most modern improvements in screw-engines in their design; they occupy small space, and have given great satisfaction so far as their working qualities have been tested, and may be considered as equal in excellence to the ships they propel: and this is no small praise, as Mr. Laird ranks amongst the first shipbuilders of the day. Their leading points we shall briefly notice. They are made up chiefly of six castings —two right and left condensers, two right and left frames, and two cylinders. The condenser-castings carry the air-pumps and cylinders, and are bolted amidships together. The sides of the condenser, in which the exhaust-pipes are formed, are carried out and flanged so as to allow of the cylinders being attached to them: a strong flange runs completely round the two condenser-castings to pass the holding-down bolts through; the top of the frames is formed so as to carry the main bearing brasses, a strong web running down to the condenser, and two arms on each side extended to the cylinder-flanges, and carrying guides for the piston cross-heads. These diagonal frames are bolted to the condenser at one point and to both cylinders; keys are fitted between the cylinder and the ends of them, so that the bolts may be screwed up without fear of straining unduly any part of the system; and thus a most substantial engine is made without employing what we may call brute force, or using a mass of metal such as we have sometimes seen—apparently sufficient, by force of gravity alone, to effect that much-desired end, a stiff job. The connecting-rods are fitted with brasses and bolts—now very generally used, as combining economy, efficiency, and appearance. The piston-rods are each cottered into cross-heads, having bearings for the connecting-rods and carrying the guide-blocks on their extremities. To one cross-head, two rods are fitted; to the other, one, having a *double jaw* and working on the crank-pin between the two lighter rods. The air-pumps are angled and worked direct from a massive eccentric. On the after end of the engines, from the eccentric strap, studs project, to work the feed and bilge pumps, which are also angled and placed on the part of the air-pump top which forms the passage to the hot-well and discharge-pipe. These studs give quite sufficient motion for a feed or bilge pump; though, moving in an oval path, they do not give the pumps the full stroke of the eccentrics. We noticed in the *Imperatrix* a small pump fitted between the air-pumps, worked by this eccentric, to supply the troops, expected to be conveyed to the Crimea in her, with fresh water. The slide-valves are worked direct by two eccentrics (two rods from each); a link-motion is used, which is one of the most elegant and perfect we have seen; the links are made so that the eccentric-rod pins are fair with the valve-rod pins when in gear. Guides are fitted to the valve-rod, which has a rectangular head to it, furnished with brasses and an adjusting set-screw. The starting-wheel shaft has a pinion, working into two racks mounted on wrought-iron levers; from these levers the radius rods are carried to the reversing links: these radius rods work on ferules, which are carried on a pin working in a cast-iron slotted bracket screwed at the end, so that the end of the lever may be firmly fastened, and become, for the time being, a fixed centre, thus avoiding the jingling and wearing often experienced in this kind of motions when it is left to the good fitting of the teeth in the rack and pinion to keep all steady.

Recently, the *Burra Burra*, a fine little screw-steamer of 435 tons burthen and 80 horse power, 165 ft. long, 24 ft. beam, was completed in Liverpool; and, still later, the *Pampero*, built by Laird, of 750 tons and 120 horse power, a paddle-steamer. The first of these was made by Cato and Miller, and fitted with a pair of geared oscillators by Rothwell and Co. We do not like to find fault with a conscientious job. No pains or expense have been spared to make these a good pair of engines, but in none of the details where they vary from the well-established and proved form made by Penn can we see superiority of design, though much increase of cost. At the same time, in our capacity of reviewers, we must condemn the practice of placing *steam-pipes upon pedestal caps*. The forward bearing of the spur-pinion is placed so close to the engines, that the steam-pipe to the after-trunnion comes over and is supported by it. The slide-valves are worked in the usual way with a quadrant, but a link-motion takes on to the pin where in Penn's engines the eccentric gab fits. This is well enough, for the vessel is intended for short voyages—between Melbourne and Adelaide—perhaps 48 hours' run; and the power of reversing quickly may save her many a mishap in those crowded and careless parts. The air-pumps are vertical, worked by a beam fixed on the top of the condenser, which, in turn, is actuated by the usual cranked intermediate shaft. The side of the condenser is carried up above the aperture for the exhaust steam-pipe. Now, the main point in making a pair of oscillators work well is to have the trunnion-packings always in order and easily accessible. By carrying the side of the condenser above the trunnion-pipe, the difficulty of getting to the gland is much increased. If the engineers could pack them with their toes, the ease would be altered; but in order to afford them room to get their hands to work, it is the best practice to carry the pipes into a hood on the condenser—as in Penn's engines—giving a man room to stoop. The valve-levers are fitted with links and guides: this, again, though not absolutely bad, is not an improvement for the better. Why discard the simple and elegant slot-motion, which is used with perfect satisfaction in engines six times the size of the *Burra Burra's?*

We also noticed that the after crank in these engines is made considerably stronger than either of the forward ones. We have seen the same practice in some of Boulton and Watt's engines. The principle upon which they proceed is, that supposing A to be the centre of the shaft, AB and AC the two cranks when in this position, the strain they transmit through the end crank together is more than what is caused when one crank is at half-stroke and the other on the centre; the sum of their diminished leverage is greater than the full leverage of one crank. In the designing of slide-valves



the present practice is, however, to allow much lap, and to cut off very early; and as the crank B is getting steam, C is losing; so that, though correct in theory, it is hardly worth the trouble of making any difference in practice.

The *Pampero* has engines on the double piston-rod direct-acting principle, like the engines of the *Bulldog*, made by Rennie. The detail is different, and does credit to the makers, Humphreys, Tennant, and Dyke. The cylinder-covers are deeply dished to get a long connecting-rod; the cross-heads are made of two wrought-iron plates, with large lugs projecting downwards, to carry the lower pin for the connecting-rod; the plates are continued, so that, being furnished with brass slide-blocks fitted between them, they guide the piston-rod vertically and laterally, the guide-blocks working on the four columns supporting the entablatures, and being still further continued, they work the air-pumps on one side, and the feed and bilge on the other. By this means, a plain intermediate shaft is obtained, and great saving in the simplicity of the pumps and rods. The valve-gearing is on the link principle; the slide-valve is worked by a rod, through which a pin passes into the slide-block on the one side, and into the eye of a rod ascending and jointed to a lever working on a strong stud in the entablature,—on the other end of which a balance-weight is fixed. The valve is made on the gridiron principle, and being balanced and of very short stroke, will doubtless work most satisfactorily. The slide-valve faces, face each other; the starting-gear mainly consists of a worm working into a segment of a worm-wheel keyed to a shaft, from which the rods to the reversing links, or radius rods, are worked by two levers. The cylinders, we understand, are $50\frac{1}{2}$ in. diameter, and stroke 3 ft.; the paddle-wheels are not more than 16 ft. over the extreme point of the boards; the arms are set so that the face of the lowest paddle is vertical. The descending weight of the cross-heads, &c., in this form of engine, is partly balanced by the feed and bilge-pumps—and might be more so, if the air-pump were made to force instead of lift.

The boilers are fore and aft. A convenient way of hanging the fire-doors is to put the hinges, not as on an ordinary door, but so as to open up and down: then, when the ship is lying to, the doors swing open, and keep open, by just knocking the catches off, the front of the boiler being inclined.

We approve of wrought-iron mountings to boilers, though cast-iron answer. Wrought-iron fire-mouths are safer and lighter. The neat appearance of this engine-room is much spoiled by the feed-pipes, &c., being carried right above the floor: we were in some doubt at first as to whether they were intended to serve as hand-rails, and hope that some other purpose besides economy was to be served when it was decided to place them so.

The donkey, externally, is simple enough. A rectangular box is bolted to the bunkers; out of the side projects the donkey cylinder and pump, both oscillating, working on to one pin. A three-way cock answers for a slide, and the pump has passages cast on it, like a steam-cylinder.

When the British Association was in Liverpool, one of the lions was a heavy fly-wheel of 35 diameter, and about 60 tons weight. This was exhibited to the members at the Mersey Forge Works. The rim of this wheel, which was cast in loam, in two pieces, by Messrs. Fawcett and Preston, weighs about 24 tons. The engine to which it is attached is a high-pressure horizontal engine of 80 horse power; when running at 24 revolutions per minute, its periphery travels at the rate of half a mile per minute. At a future day we may return to this subject.

CORRESPONDENCE.

MUNTZ'S PATENT METAL.

To the Editor of The Artizan.

Sir,—I beg to bring before the public, through the columns of the Artizan, a subject of inquiry of the greatest importance to our mercantile navy, and which requires an immediate investigation; namely, whether mixed metals (Muntz's patent), when used for the bolting of vessels, retains when exposed to the action of sea-water its tenacity and ductility; because, in every case in my experience where it has been necessary to have bolts removed, I have found them broken asunder, or so brittle that the slightest force was sufficient to break them. In fact, from the appearance of the fracture, the nature of the metal seems to be completely changed, having more the appearance of brown earthenware than of metal.

It is also a fact every day made more apparent, that the same metal when used as sheathing becomes so brittle in a few years that it may be crushed in the palm of the hand. If such is the case in the sheathing, the same agency may be supposed to be at work on the bolts when exposed to the action of sea-water. In proof of these assertions, I enclose you some specimens of the metal, showing the different stages of decomposition.

This subject would form a very important problem for chemistry to investigate. In my opinion, there must be some voltaic action in operation when the metal is exposed to sea-water—the metal being composed of copper and zinc. It may be possible that the zinc may be destroyed, as it is in a galvanic battery. At any rate, it is the fact that the metal does undergo some very great chemical change, rendering it unfit for the bolting of vessels; and I do not think that chemists could have a more important subject brought before them, or one the elucidation of which would confer greater benefit on humanity.

In conclusion, I beg to point out that the most prominent parts of a vessel—such as the stem, keel, and stern-post—are bolted wholly with this metal. In the event of many of the casualties common to navigation, vessels must be brought into great peril when fastened with bolts formed of so treacherous a material, and I have not the slightest doubt that many of the ships that are never heard of are lost in consequence of the bolts having lost that tenacity and ductility so necessary to enable them effectually to fulfil the purposes for which they are employed.

I am, Sir, your most obedient servant, R. Armstrong.

PUFFING SMOKE PATENTS.

OUR LITERARY AND SCIENTIFIC AND MECHANICS' INSTITUTIONS.

To the Editor of The Artizan.

Sir,—I do not know whether it may be in accordance with your knowledge and experience that a very great change, and that for the worse, has come over our mechanics' and other such institutions.

I can well recollect, say about fourteen or twenty years back, that the lectures which I used to attend then were of a very high order indeed. Courses of, say six or twelve, lectures on a given subject, such as natural philosophy, chemistry, astronomy, &c. &c., were then common, and the lecturers were generally gentlemen who understood their subjects; and there cannot be a doubt that the lecture-table then was a very excellent educator.

Gradually this class of lectures and lecturers have been superseded, and these institutions have become, as far as the lecturing branches are concerned, in too many cases, places of amusement and recreation; and the class of men for whom these institutions were originally designed have deserted them, or have been driven away. The cause or causes of all this I am not prepared to investigate; but what I want to bring under your notice at this time, that you may stamp on it the strongest mark of disapprobation, is, that a new feature has appeared in these institutions which I do trust will soon be put down; namely, making the lecture-room a convenient place for puffing the *patent* of some dear friend.

I was invited to hear a lecture on the smoke-nuisance, the other week, at the Literary and Philosophical Society of Portsmouth. The lecturer was a local celebrity of the medical profession. Those who went to hear this very important subject treated in a calm and scientific manner came away much disappointed. Instead of entering on the merits of the question, which, from his local fame, it was fully expected he would have done, (I might, however, except a small part of the lecture, which consisted of a large quotation from your pages of August last, containing a report of Dr. Arnot's paper,) he proceeded, in the most offensive and bombastical style, to explain, illustrate, and set forth the various excellent perfections of Mr. Prideaux's smoke-consuming apparatus. All who had not adopted it were anathematised, and more particularly the Chief Engineer of her Majesty's Navy, who, it was asserted, had for three years refused to adopt it in the Royal Navy; and for this the lecturer could almost identify him with the enemies of our country.

Now, Sir, whether it was that the lecturer was in total ignorance of his subject and but superficially *primed* for the occasion, or whether it was returning the *puff dedicatory* which will be found in Mr. Prideaux's "Treatise on Fuel and Reverberatory Furnaces," in either case it was most ungraceful, and very much to be deprecated in an institution established for the purpose of diffusing a knowledge of science.

A discussion followed, in which Mr. Spence, of the Steam Factory of Portsmouth Dockyard, took a part. It was evident that Mr. Spence was rather nettled at the way his profession had been handled. He made some pertinent remarks which pressed rather close home on the lecturer, who, in reply, acknowledged that he was an *amateur*, and not able to meet in discussion a practical man.

Mr. Spence, not satisfied with this tilt with the lecturer in the lecture-room, has published in one of the local papers a letter which, in my estimation, contains matter worthy of more general circulation. I beg to enclose his letter, which appeared in the "Portsmouth Times" last week, and which I shall be glad to see in your pages if you can find room. Practical.

[We cannot find room for Mr. Spence's letter at present.]

THE COMBINATION OF METALLIC AND ELASTIC SUBSTANCES FOR PISTON-PACKING.

To the Editor of The Artizan.

Sir,—In your "Notes on Designing Steam Machinery, No. 8," in this month's number of the Artizan, you suggest the combination of vulcanised India-rubber with metallic packing for pistons.

In the month of June last, we introduced vulcanised India-rubber behind the metallic packing of an engine we were repairing; but before working a month, we had to take it out again, as it had become so far dissolved as to completely glue together the piston, springs and junk-ring, and coat the inside of the cylinder so that the engine would not move while the steam was blowing off at the safety-valve under a pressure of 25 lbs. per square inch. So completely were the springs glued to the piston, that we had to use great caution lest we should break the springs when removing them.

We are, Sir, yours most obediently,

Hoey, Kennedy, & MacGregor.

56, *Cook-street, Glasgow, Dec.*

[Our Correspondents appear to have had the misfortune to fall in with inferior vulcanised India-rubber, as it ought to have stood with impunity any steam temperature which they would put upon it in an ordinary steam-engine.

Vulcanising caoutchouc, we may observe, consists in subjecting it to an intense heat, and volatilising all its volatile substances, impregnating it with sulphur, and finally submitting it to a high steam temperature; and we have no doubt that the material which our Correspondents have used, has been of imperfect manufacture, and contained a considerable portion of its original volatile matter—that is, it has not been properly vulcanised.

We have a sample of elastic packing before us which does its work well, even where there are no metallic rings. This is a mixture—a series of alternate strata of canvass and vulcanised India-rubber, which possesses nearly the elasticity of the latter, and, of course, the cohesive power and durability of both combined; and we have never known the India-rubber to dissolve, or the packing to prematurely perish: but care should be taken to place it with the grain, so to speak, against the rubbing or rubbed surface, so that both canvass and India-rubber take each an equal share of the work. Should, therefore, there be any difficulty in procuring properly-vulcanised India-rubber by itself, the packing we have named will, we think, be found all that need be desired in the present state of things, either as a packing for glands by itself, or as an elastic belt between metallic rings for pistons in the manner we suggested; though, for our own part, we should prefer the India-rubber, if the manufacturers issued none but good material.]

NOTES AND NOVELTIES.

Cowburn's Oscillating Safety Valve.—The subjoined engraving represents a form of safety-valve which is being extensively manufactured by Messrs. Bellhouse and Co., of the Eagle Foundry, Manchester. The objects of this invention are to remove the liability of the valve to be tampered with to a dangerous extent, and to prevent it from sticking—both, no doubt, fruitful causes of boiler explosions. The first object is attained by weighting the valve on what may be termed a direct principle, the pressure being varied by adding or removing one or more of a series of cake-weights, each of which may represent or give a pressure of 2, 3, or 4 lbs. per square inch. The second object is attained by having a spherically-formed valve, and giving room for the weights to gyrate, so as to admit of the valve being moved on its seating, and thereby preventing the adhesion or cementation of the surfaces in contact. Our illustrations show two modes of application used

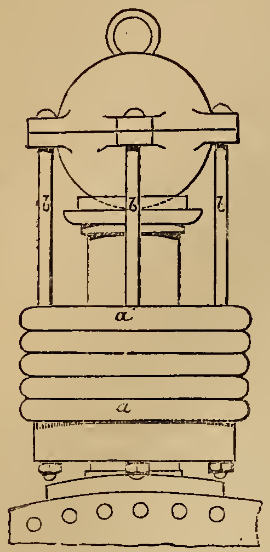


Fig. 1.

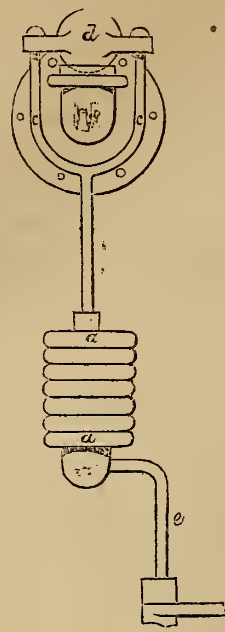
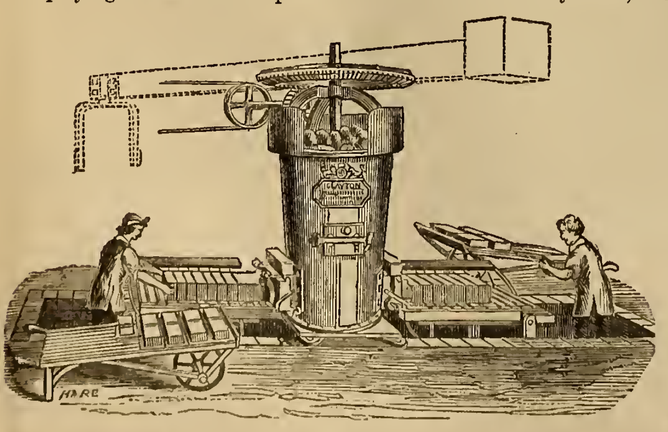


Fig. 2.

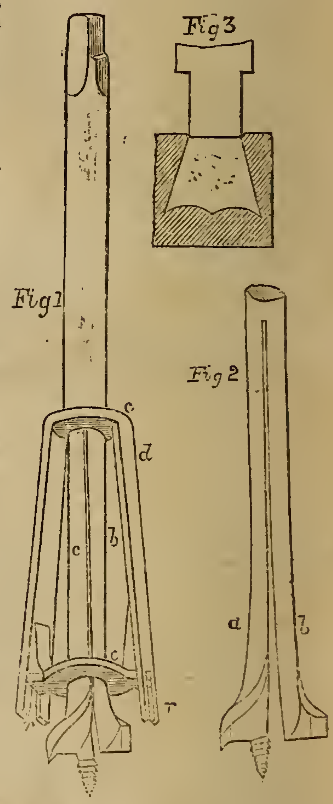
by the inventor—Fig. 1, a large valve for the top of the boiler, and Fig. 2, a smaller one for the end, and which may be under the immediate control of the man in charge. In the former case, the cake-weights, *a*, are suspended by four rods, *b*; in the latter, by means of a stirrup, *c*, passing around the valve-seating, *d*, which is so placed that the weights are contiguous to the pin, *e*, of the fire-door hinge, this pin being cranked so as to give a gyrating movement to the weights when the fire-door is opened, and all probability of the valve sticking is thereby prevented. Nevertheless, this latter form of valve appears to us highly objectionable in not having some means of preventing the valve being thrown off its seating by any accident: this could never possibly be tolerated on board a steamer. With respect to the general principle of the valve, we believe its advantages are too obvious to require further comment; but we are bound in all candour to say that it is remarkably like Mr. Nasmyth's of Patricroft, particulars of which will be found in the Artizan, vol. ix., p. 129; the only difference in fact being, that Mr. Nasmyth's is a lock-up valve and loaded in the inside of the boiler.

Clayton's Brickmaking Machine.—This machine is very simple and economical in construction—prepares the clay and makes the brick at the same time, and can be worked by horse or steam power. It consists of a cast-iron cylinder, with a vertical shaft running through the centre, the upper part of which is furnished with the requisite gearing for employing horse or steam power. In the inside of the cylinder, and



keyed into the shaft, are a number of wrought-iron knives revolving horizontally and in different planes, similar to a pug-mill, which reduce the clay to a proper consistency and force it downwards. Near the bottom of the shaft are fixed four wrought-iron arms, slightly curved backwards, with their faces vertical, the object of which is to force the clay through the dies which give the required shape to the brick; and the clay, after passing along an endless band, is cut into the proper thickness by a series of wires. When we last noticed this machine (vol. xi., p. 284), we explained that the sides of the dies consisted of rotating vertical cylinders, and thereby produced and maintained a sharpness in the arris of the bricks hitherto unattainable in their manufacture through dies. When those observations were penned, motion was communicated to these cylinders only by the volume of expressed clay: Mr. Clayton has since prolonged vertically the axis of each cylinder, fixed a pinion and pulley at its top, and provided the necessary gearing so as to communicate motion direct from the power employed—which overcomes many objections to the old method. Mr. Clayton's machines are now too well known and appreciated to require any recommendations from us; but we may add that, in addition to numerous testimonials and specimens from various parts of the United Kingdom, Mr. Clayton has at present orders from Philadelphia, United States, and Geelong, Australia.

Improved Expansible Bit.—The accompanying figures represent an improvement in expansible bits, for which a patent was granted to Clinton L. Adancourt, of Troy, N. Y., on the 27th of August, 1851, but which is now for the first time prominently brought before the public.



The nature of this improvement consists in making expansible bits for boring conical holes any given distance into the material, and chip the core so that it is discharged from the hole without the necessity of boring through the material, and so forming it that tenons may be firmly wedged in mortices, enclosing the tenon entirely.

Fig. 1 is a perspective view of the complete expansible bit; Fig. 2 is a view of the bit itself fully expanded, without its collar; and Fig. 3 is a section showing the form of conical hole made with the bit, and also the manner of wedging a tenon in it.

A bit or auger is formed in the usual manner, and then divided longitudinally into two unequal parts—the larger part, *a*, having the centre, and the other part, *b*, operating on a spring, at the point of which is the expanding cutter. The collar, *c c*, is then placed upon the shank and presses the two sides of the bit together. This collar has wings, *d*, and projecting points, *a a*, extending down to the line of the cutting points of the bit. When the bit is brought into operation, these points, *r r*, rest upon and are held firmly against the material to be bored: therefore, as the bit progresses or bores into the timber, the collar is pushed upwards, freeing the bit and allowing it to expand gradually to form a conical hole, as shown in Fig. 3, in which a tenon can be wedged neatly and permanently—impossible to be drawn apart or work loose. For very deep boring an extra collar (forming a tube placed around *a b*, and embraced by *c c*) is employed, and the claim of the patent covers the expansible bit in combination with a single or double collar constructed and operating as described.—*Scientific American.*

Consumption of Coal in the United States.—The consumption of coal does not increase so rapidly as was supposed. In 1852 the increase was less than 13 per cent., and left a surplus in the market. In 1853 the increased supply was less than 9 per cent., from all sources. To this, of course, is to be attributed the high price of coal during the latter part of the year; but taking the average over 12 per cent., it will reach it. We see no good reason to believe that this average percentage in the demand is likely to be exceeded in the present year, which would require an increase in the supply of about 623,330 tons in 1854, from all sources, to keep the market healthy. The increased supply can easily be furnished by the different regions, provided dealers and customers will come forward and take coal early in the spring. The following is a summary of operations in Schuylkill county:—

Total number of collieries	113	Number of operators	82
Red ash collieries	58	Employed at collieries	9,792
White ash collieries	55	Miners' houses out of towns	2,756

Whole capital invested in these collieries	3,462,000 dollars.
By individual operators, about	2,600,000 ,,
Thickest vein worked at Heckslierville	80 feet.
Smallest	2 ,,

All the coal-lands now worked in Schuylkill county are owned by six corporations and about 60 individuals. About 25 of the owners reside in Schuylkill county, and the balance abroad. The coal-rent will average 30 cents a ton. The product of 1853 in Schuylkill county was 2,551,603 tons. This would give an income of 765,480 to the landholders in the shape of rents for the year.—*Postville Mining Journal.*

Goddard's Patent Duplex Gas Burner.—This useful invention will be readily understood by referring to the engravings. By turning the glass-holder from right to left, the Argand burner will be extinguished

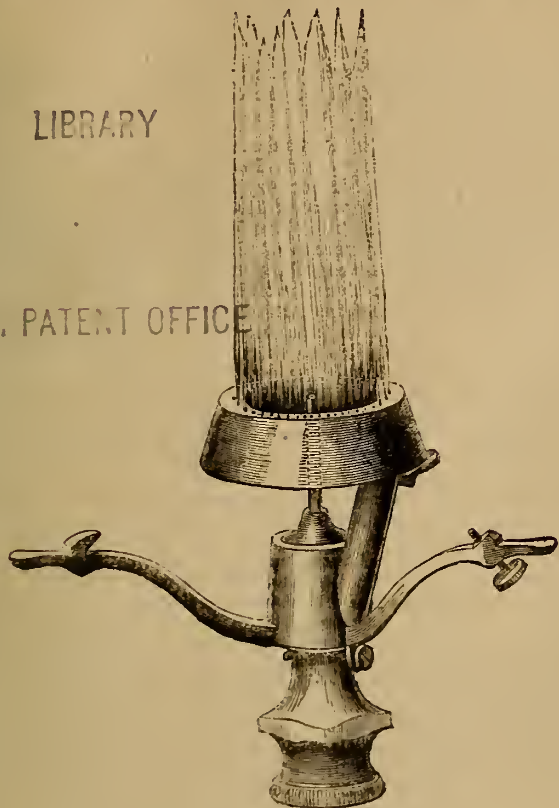


Fig. 2.

and the taper burn to a height of three or four inches, if necessary; and by bringing the set-screw to the stop on the left, the small jet only, as

Fig. 1.

in Fig. 1, will remain. To extinguish entirely the gas, the holder must be turned from left to right. The advantages claimed by the patentee for this burner are, that it combines a cock and burner, and also that it economises the gas, a constant light being maintained at a small cost. A burner may be seen at Messrs. S. and E. Ransome's, the promoters of the patent, 31, Essex-street, Strand.

On the Incrustation of Steam Boilers. By M. Cousté.—In the "Annales des Mines" for the present year is an interesting paper by M. Cousté on the incrustations of steam-boilers, and the methods for preventing their formation. He commences by pointing out that the prevention of incrustations, if realised, would produce a better preservation of the boilers, greater security against explosions, and considerable economy in fuel. For steam-vessels it would be attended with an increase of available space for cargo, and the use of steam at high pressure.

He then presents the results of his investigations on the nature of deposits, and the circumstances connected with their formation, whether in boilers fed with salt or fresh water.

M. Cousté suggests four methods for preventing incrustations. The first is, in fact, the well-known method, which consists in extracting from the boiler, either at intermittent periods or in a continuous manner, a certain quantity of water saturated with solid matter. He thinks this process imperfect for low-pressure engines, and quite useless for those at high pressure. He proposes, however, to make some further improvements in it, as the greater number of marine steam-engines work at low pressure, and may thus be in some measure benefited.

The second of the methods described is called by M. Cousté *alimentation non-hydrique*, and requires the use of Hall's condensers. The principal objection to this method is the existence of a counter-pressure in the cylinder during too considerable a part of the stroke of the piston. By calculation, he finds that from about 25 to 30 per cent. of force is lost in a low-pressure engine.

The third method consists in continually employing the same water for condensing the steam, and, of course, requires that this water must continually pass through a refrigerating process.

The fourth method, which belongs entirely to M. Cousté, consists in feeding the boiler with water heated to a very high temperature (at least 318° Fahrenheit) before being introduced into the boiler. This process has the effect of completely precipitating all the calcareous salts held in solution by the water.

The process requires a special heating apparatus, and a filter for separating the precipitate. The author remarks that the filtering which is necessary for engines at ordinary or low pressure, or for high-pressure engines working occasionally, might be dispensed with for marine high-pressure boilers, because the salts precipitated in the heater cannot again dissolve in the boiler, and consequently cannot crystallise, but will only form a muddy deposit instead of a fixed incrustation.

Finally, in comparing these different methods, M. Cousté thinks the last should be preferred for navigation, whether in salt or fresh water, and exclusively employed for locomotives; while the third more cumbrous method could be advantageously used for land-engines under certain locally favourable conditions.

In order to accurately estimate the value of keeping the surfaces of boilers clean and clear from incrustation, M. Cousté has mathematically investigated the loss of heat which takes place in causing the water in an incrusted boiler to arrive at a given temperature. He does this by comparing two boilers of the same shape and dimensions, placed under precisely the same conditions, except that one is covered with a calcareous incrustation all over its heated surface, while the other was free from deposit, and covered only with a thin coat of rust. They are supposed to be so managed as to produce equal quantities of steam in equal times. It follows that the heat of the fire under the incrusted boiler must be increased; hence a great loss of heat by the rarefied air and gas escaping through the chimney, and by the external radiation from the furnace. The first of these causes of loss is of course the most considerable, and it is it alone that the author has sought to estimate. This he does by the aid of some hypotheses which enable him to establish his fundamental equations. From these he finally deduces the formula—

$$\frac{\Pi}{P} = \sqrt{(1 + 2\,M\epsilon)}$$

where Π represents the loss of heat in the incrusted boiler due to the causes mentioned, P the loss in the non-incrusted boiler, ϵ the thickness of the calcareous crust; and

$$M = \frac{\frac{K}{K'}\left(1 - \frac{b}{A}\right)}{e + K\frac{\eta}{\gamma}}$$

in which K is the coefficient of conductivity of the boiler-plates, K′ of the calcareous crust, b the temperature of the water in the boilers, A the mean temperature of the heated surface of the non-incrusted boiler, e the thickness of the boiler-plates, η the thickness of the coating of rust, and γ its coefficient of conductivity.

By the aid of these formulæ, the loss of heat occasioned by incrustation in steam-boilers covered with deposits not exceeding two-tenths of an inch in thickness is calculated to amount to 40 or 50 per cent.

That a considerable loss must be produced by boiler incrustations is thus proved, but it seems to be somewhat exaggerated. One result of these calculations seems, however, to be well established—namely, that the consumption of fuel increases rapidly with every increase in the thickness of incrustation.

M. Cousté makes highly-interesting remarks on the nature and formation of the deposits. He distinguishes the deposits of marine boilers from those fed with fresh water. The former consist chiefly of sulphate of lime, and contain not a trace of carbonate of lime; while the latter are formed both of sulphate and carbonate in proportions varying with the localities.

He also distinguishes deposits which are merely muddy, or formed of matters suspended but not dissolved in the water, and which are formed of magnesia, oxide of iron, silica, &c., from the crystalline deposits which commence to form when, during the progress of evaporation, the water has arrived at a state of saturation with respect to the salts forming the deposits.

An important fact resulting from M. Cousté's observations is, that the state of saturation is brought about the sooner the water attains to a high temperature; that is to say, that the solubility of the sulphate and carbonate of lime diminishes in a rapid proportion as soon as the temperature rises above the boiling point. Between this and the freezing point, the former of these salts has for temperature of maximum solubility 95° Fahr., and at 212° its solubility is not much greater than at 32°. Hitherto the law of solubility beyond the boiling point has not been examined; and M. Cousté is perhaps the first person who has shown that at temperatures somewhere about 320°, which corresponds to a steam-pressure of four or five atmospheres, the solubility is almost destroyed. Upon this fact is founded the principal method proposed by M. Cousté for remedying the formation of incrustations.

He also explains by this circumstance the difficulties which have hitherto interfered with the use of high-pressure engines on board sea-going vessels.—*Journal of Industrial Progress.*

Comparison of Iron and Wooden Vessels.—In a note attached to his translation of Fincham's "Outline of Shipbuilding," M. Nillus, of Havre, makes some interesting remarks on the comparative advantages of wooden and iron vessels, which we here present in an abridged form.

Almost all vessels, whether in wood or iron, have hitherto been constructed on a wrong principle. The greatest possible strength has been given to the sides and bottom, while the deck has been neglected. But a ship should be regarded as a great tube or box, capable of sustaining a load at its middle while suspended at its ends, or conversely of sustaining loads at each end while supported at the middle.

To obtain this result with the least weight of materials, the upper and lower parts of the vessel, otherwise the *deck and the bottom, should be the strongest.* Instead of this, the deck is usually slight and weak, and is generally regarded only as a platform to be used for working the ship, or as a covering to keep the water from the interior of the hull.

Iron ships should form a tube, closed at each end, and strengthened by ribs and cross-beams forming continuous pieces, so that the tube might be considered as strengthened by a series of rings. The sides should, of course, be rivetted to the ribs, so that the whole would form something analogous to a tubular bridge. Even the present construction of iron steamers is much superior in solidity to that of wooden ships, as a few examples will suffice to show. The *Great Britain* remained during the entire length of a severe winter fixed on the rocks at Dundrum, and when released from her critical position was capable of being so repaired as to become a packet-ship to Australia. A recent example is furnished by the *Ward Queen*, constructed by Scott Russell, with a length twelve times as great as her maximum breadth—a very high proportion for a sea-going vessel. This small steamer was employed between Newhaven and Dieppe at the period of the accident. In entering the port of Newhaven, at low-water, with the channel too shallow, she grounded heavily and was suspended by the middle. A breaker took her broadside on and cast her on the beach, where the passengers easily and safely disembarked. Notwithstanding the force with which she was cast ashore, she was again launched without any strain, and was able to proceed to London for examination. After a careful inspection, no important injury could be discovered. A wooden vessel of the same dimensions, under similar circumstances, would doubtless go to pieces, or, at least, be seriously damaged.

To show that the annual cost of wear and tear is less with iron than with wooden vessels, M. Nillus refers to two steamers, each of ninety-horse power, on the packet-service between Dover and Calais. One of these, the *Midgeon*, is of wood, and cost £10,121; the other, the *Dover*, is of iron, and cost £10,153. The annual repairs of the *Midgeon* cost £668, whilst those of the *Dover* cost only £293. The wooden vessel thus requires 6·6 per cent. of her first cost for annual wear and tear, while only 2·87 per cent. of her first cost is required for the iron vessel. This extraordinary proportion in the relative cost of wear and tear in these two vessels might be, in part, attributed to the *Midgeon* being two years older than the *Dover;* but this would be far from completely explaining it.

Hitherto iron vessels have entirely failed for the purposes of war. Numerous experiments made in France and England have clearly demonstrated their inapplicability. A ball fired at an iron hull strikes the side, and continuing its course right through, will come out of the other side; sometimes it breaks into dangerous splinters, which kill and wound in all directions. Moreover, it is impossible to perfectly close up the hole left by a cannon-ball in the iron plate, from the jagged edge turned to the interior of the ship. M. Nillus concludes that iron is much preferable to wood as the material for merchant and passenger vessels, but is entirely unsuited for the construction of ships of war.—*Journal of Industrial Progress.*

On the Separation of Silver from Lead. — At a meeting of the Royal Cornwall Polytechnic Institute, Mr. J. A. Phillips, of London (formerly of the Museum of Economic Geology), said that one of the most important improvements which had recently been made in the metallurgical art came into operation last year, and is the separation of silver from lead by means of zinc. After describing the old process of separation, and the subsequent process discovered by Mr. Pattinson, of Newcastle-on-Tyne, involving several crystallisations and a final cupilation, he stated that still more recently a patent had been taken out by Mr. Parkes for a process by which he separates the silver entirely by one operation. To do this, the alloy of silver and lead is melted in the usual way in a large iron pot; to this a small quantity, a few pounds of zinc per ton, is added, the whole mixed up and allowed to remain a short time. By this means the silver is brought to the surface in the form of alloy with the zinc, and this mixture is subsequently skimmed off and treated for the silver it contains. In order to do this, the zinc is first partially separated by oxidation, and the residual alloys afterwards treated in the cupel. In connexion with the purification of metals, he might mention some of his own experiments in regard to tin. The tin from Peru and some other countries contains a large amount of tungstan, or wolfram, which very much depreciates its value. Till recently this tin could only be employed for very common purposes, such as making tin pipes and other things which did not require tin of good quality. But in analysing some of this tin he happened to discover a process by which the separation was very easily effected, and this process had been recently patented. It consists in taking impure tin, containing from 5 to 10 per cent. of tungstan (worth £25 per ton less than tin of ordinary purity), granulating it by melting it in a reverberatory furnace, and allowing it to flow into a vessel containing water. This granulated tin is then placed in a pan with common hydrochloric acid, which may be obtained from the soda manufacturers at almost a nominal price. This being heated, hydrogen gas is evolved, and a solution of chloride of tin is obtained. In this operation it is necessary that the tin should be present in excess; unless it be so, a certain portion of tungstan is dissolved. Should, however, the operation be carried on too far, and a portion of tungstan be dissolved, the addition of a small quantity of impure tin precipitates the tungstan, and chloride of tin, free from tungstan, is obtained. This is turned off into a vat, in which more granulated impure tin is placed, and any arsenic or antimony remaining is there deposited, and a pure solution of chloride of tin obtained. From this we have to get the chemically pure tin we require, and which is quite as good as the stream tin of Cornwall. Into this bath we put bars of metallic zinc, which precipitates the tin in a spongy mass, when instead of chloride of tin we get chloride of zinc. The tin thus produced may be fused into bars, or sold as the best tin. The chloride of zinc must be so used as to lower the expense of the whole process. To do this, it is precipitated by milk of lime, or common chalk; we then get oxide of zinc, which is largely used as a pigment; and to give it sufficient opaqueness for that purpose, the washed oxide of zinc is heated to redness, when it is found to be equal to the ordinary oxide of zinc obtained by sublimation.

New Drawbridge.—A neat model, embodying a design for a drawbridge which promises many advantages over the ordinary modes of construction, has been designed by Mr. James Brunlees, civil engineer, Manchester, and is about to be carried into effect on the Ulverstone and Lancaster, where the line crosses the navigable estuary of the Leven, near Ulverstone. The estuary being exposed to high winds, and having strong tides running through it, necessitated the adoption of a structure whose light character would present the least resistance to the force of the winds and the occasional lash of the waves; while at the same time the moveable part of the bridge should be of sufficient span to admit the passage of vessels, combined with ample strength to support a railway train. The Leven estuary, which has a bed of sand, is at this point a mile in width, and will be crossed by an embankment having a viaduct constructed of iron in it. In this viaduct will be placed the drawbridge, the roadway of which is for a single line of rails, resting on piers constructed of iron piles. The waterway for the vessels will be 36 feet wide, to be spanned by a moveable platform, formed on two light wrought-iron lattice-girders. The opening of the bridge will not be by the old plan of raising the platform into a nearly vertical position—or of swinging it to one side, which, with a blast from the Irish Sea, would jeopardise its stability and efficiency of working—but by causing it to glide under the fixed roadway, on one side the opening, thus forming a kind of telescope-bridge. The mode of accomplishing this is, first, by making the moveable platform 78 feet long, which is double the length of the open part, and 6 feet over for surplus counterbalance; and then making provision for easily moving it beneath the fixed line, in the direction of the bridge's length. This provision consists of a lower line of rails, fixed on beams which have a slight declination at the counterbalance end. There are three pairs of wheels attached to the girders, and these resting on the lower line just mentioned, facilitate the movement of the platform, a rack and pinion, worked by one man, being sufficient to overcome the friction. The fixed roadway is formed of cross T irons for a length equal to the open span, thus affording clear space for the admission of the platform beneath it. When the bridge is closed, by passing the platform over the span, it will be perceived that, owing to the inclination of the lower or platform rails, the counterbalance end is on a somewhat lower level than the fixed line. To raise it to the same plane, an eccentric is placed under each girder, the eccentrics being connected by a shaft, which is worked by a rack and screw motion. The advantages contemplated in this design are, small expense at first cost, with great facility and certainty of opening and shutting, under all circumstances, and requiring no extra provision for foundations, the weight of the whole moveable platform being dispersed in its bearings, and only weighing about thirteen tons. The design (which is patented) seems to be equally applicable for docks, canals, or other situations necessitating a drawbridge; and from the simplicity of its arrangements, and its compact appearance (compared with other cumbrous contrivances which we have seen), we should think it likely to be generally adopted.—*Railway Times.*

Hartlepool Great Float and Railway.—The plans deposited under this title propose to occupy 80 acres on the margin of the slake (which contains upwards of 170 acres, and averages $4\frac{1}{2}$ feet below high water)—to extend the old tidal harbour considerably inland, and over the site of the present sluices—to deepen the whole harbour by dredging, and extend the jetty-pier out to the line of the old pier on the Hartlepool side. The great float is to be excavated to 12 feet below low water, so as to provide ample accommodation for the largest class of ships, steamers, and others sharp-built (which cannot touch the ground) in the event of the gates falling or being left too long open. The great float has also an outlet into the west harbour, leaving the centre of the slake unoccupied adjoining Middleton. The engineers of this great scheme are Mr. James Abernethy, C.E., London, and Mr. Thomas Meik, C.E., Sunderland. It will be remembered that when the fearful gales of last winter strewed the shores of our coast with wrecks, involving a great sacrifice of life and the loss of much valuable property, the latter gentleman published a plan, under the title of the "Hartlepool Bay Harbour of Refuge," which embraced the above scheme, together with the enclosure of the bay by two great piers running out into deep water on one side from the Heugh, and on the other over the Long Scar Rocks. Plans for such piers, slightly modified, have also been deposited by the commissioners of the pier and port, prepared by their engineer, Mr. Rendell, C.E.

DIMENSIONS OF STEAMERS.

PARTICULARS OF THE STEAMER "CLYDE."

Hull built by Scott, Sinclair, and Co.; machinery by the same firm. Intended service, New York to Glasgow.

Hull.—
Length on deck ... ... 250ft.
Breadth of beam ... ... 31ft.
Depth of hold ... ... 21ft.
Draught of water at load-line... 17ft.
Do. do. below pressure and revolutions ... ... 15ft.
Masts and rig, three-masted brigantine.

Engines. — Inclined athwartship; geared $2\frac{1}{4}$ to 1; diameter of cylinder, 52 inches; length of stroke, 3 feet 10 inches; pressure of steam in pounds, 12; revolutions per minute, 34. *Boilers.*—Four, tubular; number of furnaces, 12; description of coal, bituminous. *Propeller.*—Diameter of screw, 12 feet; pitch of, 15 feet; number of blades, 3. *Remarks.*—Frames, shape and dimensions, ⅂L $5\frac{1}{4} \times 3 \times \frac{1}{4}$ inches; distance apart at centre, 15 inches. Plates, thicknesses, 1 inch to five-eighths. Kelsons, number and dimensions, 3; one a box kelson, and two ⅂L on the sides. Is ceiled with wood to turn of bilge. Is clincher-built, and abut riveted.

PARTICULARS OF THE STEAMER "CLEOPATRA."

Hull built by William Denny and Brother, Dumbarton; machinery by Tulloch and Denny. Intended service, Liverpool to Portland and Montreal.

Hull.—
Length on deck ... ... 228ft.
Breadth of beam at midship section ... ... 32ft.
Depth of hold ... ... 25ft. 2ins.
Length of engine and boiler space ... ... 63ft.
Tonnage 1,138
Masts and rig, ship.

Engine.—Vertical beam; diameter of cylinder, 62 inches; length of stroke, 4 feet 6 inches; maximum pressure of steam in pounds, 10; weight of engine, 150 tons. *Boilers.* — Two, tubular; length of boilers, 9 feet; breadth, 12 feet 9 inches; height, exclusive of steam-chimney, 12 feet 4 inches; weight, without water, 150 tons; number of furnaces, 8; length of grate-bars, 6 feet 6 inches; number of tubes, 580; internal diameter of tubes, $3\frac{1}{4}$ inches; length of tubes, 6 feet; diameter of smoke-pipes, 5 feet 11 inches; height, 40 feet; description of coal, bituminous. *Propeller.*—Diameter of screw, 14 feet; pitch, 18 feet; number of blades, 2. *Remarks.*—Frames, shape, and dimension, ⅂L 5 by 3 inches, and $\frac{9}{16}$ inch; distance apart at centres, 18 inches. Plates, thicknesses, $\frac{3}{8}$, $\frac{11}{16}$, $\frac{9}{16}$, and $\frac{1}{2}$ inches. Has 6 water-tight bulk-heads, clincher-built, with abut riveted.

PARTICULARS OF THE STEAMER "INDIANA."

Hull built by C. J. Mare and Co., London; machinery by Maudslay, Son, and Field, London. Intended service, East Indies.

Hull.—
Length on deck from fore part of figure-head to after part of stern-post above the spar-deck ... ... 270ft. 3ins.
Length on deck from taffrail to stern ... ... 253ft. 7ins.
Length on deck ... ... 240ft. 3ins.
Breadth of beam at midship section... ... ... 38ft. 4ins.
Depth of hold ... ... 27ft. 10ins.
Do. do. to main-deck 20ft. 4ins.
Draught of water at load-line... 17ft. 4ins.
Do. do. below pressure and revolutions ... ... 15ft. 6ins.
Tonnage 2,500
Masts and rig, barque.

Engines.—Inclined athwartwise; diameter of cylinder, 55 inches; length of stroke, 2 feet 6 inches; maximum pressure of steam in pounds, 12; maximum revolutions per minute, 50. *Boilers.* — Four, tubular. Description of coal, bituminous; draft, natural; consumption of coal per hour, 2,800 pounds. *Propeller*—of Maudslay's patent, connected direct to engine; diameter of screw, 15 feet; pitch of screw, 21 feet; number of blades, 2. *Remarks.*—Frames of wrought-iron, 1Z, 4 and $5\frac{1}{2} \times \frac{5}{8}$ inch. Floor-timbers, moulded, $5\frac{1}{2}$ inches; sided, $\frac{5}{8}$ inch. Distance of frames apart at centres, 14 and 22 inches. Thickness of plates, $\frac{7}{8}$, $\frac{3}{4}$, and $\frac{5}{8}$ths. One air-pump in common. Clincher-built and single-riveted. Frames are alternately single and double, as above shaped, and are connected athwartwise by an iron plate, 16 inches deep at the kelson centre-line.

LIST OF PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 18th August, 1854.
1815. F. C. Calvert, Manchester—Iron manufacture.

Dated 22nd August, 1854.
1839. T. Lees, Stockport—Lubricating steam-engines.

Dated 23rd August, 1854.
1852. J. H. Young, 68, Great College-street, Camden-town—Railways

Dated 4th September, 1854.
1936. J. F. H. H. H. de Lavaur, Paris—Waterproof wrappers for packing goods

Dated 8th September, 1854.
1950. S. Frearson, Glascote—Buttons. (A communication.)

Dated 14th September, 1854.
1997. C. F. Stansbury, 17, Cornhill—Machinery for making lock-springs. (A communication.)

Dated 3rd October, 1854.
2118. W. Tatham, Rochdale—Spinning machinery.

Dated 7th October, 1854.
2153. C. Blunt, Sydenham, and Dr. J. I. W. Watson, Wandsworth—Artificial fuel.

Dated 10th October, 1854.
2166. S. Hancock, Nottingham—Looped fabrics.
2167. J. R. Jackson and W. Howler, Sheffield—Prevention of smoke.
2168. G. W. Knocker, Dover—Motive-power.

Dated 14th October, 1854.
2203. L. Monzani, Greyhound-place, Old Kent-road—Brushes and brooms.

Dated 17th October, 1854.
2216. G. and E. Scheutz, Salisbury-street—Calculating machinery and printing results.

Dated 18th October, 1854.
2225. W. Essex, Gloucester—Securing goods on and loading railway-trucks.
2227. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Preventing collisions on railways. (A communication.)

Dated 21st October, 1854.
2244. J. Bernard, Club-chambers, Regent-street—Stitching machinery.

Dated 30th October, 1854.
2303. G. H. Lille, De Beauvoir-grove, Kingsland—New material for paper

Dated 31st October, 1854.
2310. T. F. Tyerman, Weymouth-street, Portland-place—Hoop-iron bondings.

2313. C. Vorster, Cologne—Ribbons.
2314. T. Prosser, Birkenhead—Steam-engine condensers.
2316. A. Craig, Paisley—Railway wheels
2318. T. Osborne and W. Eldred, Leicester—Stopping railway carriages.

Dated 1st November, 1854.

2320. J. and W. Bradshaw, Blackburn—Time-pieces.
2322. J. B. Robb, Boston, U.S.—Railway brakes.
2324. H. Brinton, Jun., and R. Smith, Kidderminster—Carpets.

Dated 2nd November, 1854.

2326. J. Gedge, 4, Wellington-street south—Grinding machinery. (A communication.)
2327. C. Hargrove, Birmingham—Annealing cast-iron.
2328. L. H. Dewey, New York—Means of putting out fire.

Dated 3rd November, 1854.

2329. H. Walmsley and J. Day, Failsworth, near Manchester—Looms.
2330. P. M. Parsons, 6, Duke-street, Adelphi—Railway axle-bearings.
2331. C. L. V. Maurice, St. Etienne (Loire)—Carbonising coal.
2332. N. Topp, J. Holt, and J. Partington, Farnworth—Hand-mules for spinning
2333. J. A. Moineau and J. G. Lemasson, Paris—Elastic mattresses and seats.
2334. E. Alexandre, Paris—Organ-pianos.
2335. J. Atherton and J. Kinlock, Preston—Dressing yarns.
2336. W. C. T. Schaeffer, 11, Stanhope-terrace, Hyde-park-gardens—Treating waste wash-waters of mills.

Dated 4th November, 1854.

2337. G. L. Baxter, Sneinton—Reaping-machines.
2338. J. Adcock, Dalston—Application of tobacco-stalk to useful purposes.

Dated 6th November, 1854.

2340. H. Bordier, Orleans—Alcohol from plants of a farinaceous nature.
2341. W. Collis, Barnes—Brewing.
2342. J. Shaw, Dukinfield—Guns and fire-arms.
2343. J. Betteley, Liverpool—Iron knees for ships' fastenings.
2344. F. R. Ensor, Nottingham—Bobbin-net or twist-lace machinery.
2345. J. Wallace, jun., Glasgow—Zincographic and lithographic printing.
2346. W. Childs, jun., Brighton—Pipes and tubes.
2347. L. A. Farjon, Paris—Jointing pipes, tubes, &c.
2348. F. J. W. Packman, M.D., Puckeridge—Air-gun.

Dated 7th November, 1854.

2349. J. K. Worts, sen., and J. Worts, jun., Colchester, and J. Page, Langham—Motive power.
2350. L. N. Langlois, Paris—Steam-boats.
2351. C. S. H. Hartog, Islington—Fire-arms and cartridges. (A communication.)
2352. E. Hogg, Gateshead—Shot and shell.
2353. A. P. How, Mark-lane—Machine for cutting metal rods and bars. (A communication.)
2354. W. H. Woodhouse, Parliament-street—Water-meter.
2356. E. Simons, Birmingham—Candlestick.
2357. T. Metcalf, High-street, Camden-town — Portable carriages, chairs, &c.
2358. J. Bird, Dudley—Reverberatory furnaces.
2359. W. Beardmore, Deptford—Railway axle bearings.
2360. J. Blackie, Glasgow—Driving-belts, straps, and bands.

Dated 8th November, 1854.

2361. G. Davis, Southampton—Taps.
2362. L. Gluckman, Dublin —Electric communications in railway trains.
2363. W. Stead, W. Spence, and S. Wood, Bradford — Combing machinery.
2364. J. Whitehead, Patricroft—Self-acting mules.
2365. J. Gray, Edinburgh—Ventilating hats.
2366. C. W. Siemens, John-street, Adelphi—Electric telegraphs. (A communication.)
2367. A. McDonald and A. McIntosh, Alexandria, N.B.—Machinery for stretching cloth to be printed on.
2368. W. E. Newton, 66, Chancery-lane—Saws. (A communication.)
2369. A. Dalgety, Deptford—Steam-boilers.
2370. E. A. Chameroy, Paris—Junction of sheet metal pipes.
2371. G. Bartholemew, Linlithgow—Boots and shoes.
2372. C. D. Cranstoun, Elgin—Railway couplings.

Dated 9th November, 1854.

2373. P. Pretsch, Sydenham—Producing copper and plates for printing.
2374. J. Halliday, Manchester—Carding-machine. (A communication.)
2375. D. Ferrier, Edinburgh—Facilitating reference to books.
2376. F. Palling, Lambeth—Preventing horses running away.
2378. S. Show, Plaistow Marshes—Template.
2379. J. R. and T. Berry, Rochdale, and T. Royds, Salford—Spinning machinery.
2380. G. T. Bousfield, 8, Sussex-place, Brixton—Machinery for turning prismatic forms. (A communication.)
2381. D. Tunks, Accrington—Watches, clocks, chronometers, &c.
2382. H. W. Harman, Northfleet—Windlasses, capstans, crabs, cranes, &c.
2383. F. Smith, York-street, Lambeth—Smoke-consuming furnace.
2384. G. Ross, Falcon-square—Articles of caoutchouc. (A communication.)

Dated 10th November, 1854.

2385. J. N. Gardener, Keir, near Dunblane—New material for paper and textile fabrics.
2386. W. L. Wigginton, Barnet—Cooking, heating, and ventilating apparatus.
2387. E. Loysel, Paris—Obtaining infusions.
2388. W. Jeakes, Great Russell-street—Heating and ventilating by gas.
2390. E. A. Lépine, Madrid—Ophthalmological powers and collyrium.
2391. S. Ellen, Hackney—Machine for washing clothes.
2392. H. Witthoff, Manchester—Construction of ships.
2393. J. Wain, Oldham—Spinning machinery.
2394. E. Rimmell, 39, Gerrard-street, Soho—Coating fabrics in substitution of India-rubber. (A communication.)
2395. F. Ransome, Ipswich—Oxides and carbonates of lead or zinc, and carbonate or sulphate of barytes.

Dated 11th November, 1854.

2396. W. Kolen, Birmingham—Ornamenting and attaching labels, cards, and window-bills.
2397. R. Hesketh, Wimpole-street—Apparatus for supplying fuel to fireplaces and stoves.
2398. J. Thomson, Dollar, Clockmaunder—Motive power
2399. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Fire-engines. (A communication.)

Dated 13th November, 1854.

2400. Hon. W. E. Fitzmaurice, Kensington-gore—Bullets, shells, and other projectiles.
2401. A. E. B. Gobert, Montmirail, France—Stamping-press.
2402. J. Armstrong, Normanton—Railway chairs and crossings.
2403. J. J. Abadie, Paris—Mode of working screw-propellers.
2404. D. Caddick, Ebbw-vale iron-works—Puddling furnaces.

Dated 14th November, 1854.

2405. J. H. Luson, Old Kent-road—Railway brakes.
2406. A. Pécoul, Marseilles—Sounding-log.
2407. J. Howarth, Poplar—Boots and shoes.
2408. L. Kirkup, Newcastle-on-Tyne—Anvils.
2409. A. Turnbull, M.D., Manchester-square—Saw.
2410. H. Law, 15, Essex-street, Strand—Guns and projectiles.
2411. P. M. Parsons, 6, Duke-street, Adelphi—Projectiles.
2412. S. Pearson, Woolwich—Gun-barrels, pipes, and tubes.
2413. P. J. Meens, Paris—Wind instrument. (A communication.)

Dated 15th November, 1854.

2415. J. M. Chevron and C. V. F. de Roulet, Paris—Machinery for textile fabrics.
2416. D. Davies, Wigmore-street—Roller-blinds.
2417. A. Warner, 11, New Broad-street—Combining metals.
2418. R. A. Brooman, 166, Fleet-street — Gutta-percha thread. (A communication.)
2419. W. H. Meriwether, Comal county, Texas—Wrought-iron posts for fences.
2420. F. J. Bramwell, 29, New Bridge-street, Blackfriars—Steam-engines and steam-hammers.
2421. A. V. Newton, 66, Chancery-lane—Soluble silicates. (A communication.)
2422. J. H. Johnson, 47, Lincoln's-inn-fields—Air-pistols. (A communication.)
2423. J. Buchanan, Glasgow—Healds for weaving.

Dated 16th November, 1854.

2424. G. H. Ingall, Throgmorton-street — Communication between passengers and guards, &c.
2425. P. Knowles and E. Kirby, Bolton-le-Moors — Machinery for cleaning, &c., fibrous substances.
2426. R. Wilson, Birmingham—Ornamental fabrics.
2427. A. E. L. Bellford, 16, Castle-street, Holborn—Silk-winding machinery. (A communication.)
2428. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Obtaining alcohol, &c. (A communication.)
2429. S. Henton, Lambeth—Saddle.
2430. W. C. Day, Strand—Portable camp-bed.
2431. J. Platt, Oldham—Brick-making machinery.
2432. W. Hann, Hetton Fence-houses—Propelling vessels.
2433. W. Low, Lloft Wen, near Wrexham—Ventilating mines.

Dated 17th November, 1854.

2434. R. Peters, 89, Union-street, Borough—Steam-engines.
2435. J. Wilson, Hopton—Printed warp fabrics.
2436. J. Bellamy, Upper-street, Islington—Graining.
2437. J. Higgins and T. S. Whitworth, Salford—Shot, shells, &c.
2438. L. Castelain, 14, St. James's-place, Hampstead-road—Pulp for paper and millboard.
2439. T. Kennedy, Kilmarnock—Projectiles.
2440. J. Macadam, M.D., Glasgow—Sizeing paper.
2441. C. Asprey, New Bond-street—Handles for dressing-cases, &c.
2442. G. T. Bousfield, Loughborough-road, Brixton—Preventing incrustation in steam-boilers. (A communication.)

Dated 18th November, 1854.

2445. R. Gaunt, Birmingham—Dress-fastening.
2446. H. R. Ramsbotham, Bradford — Combining fibrous substances.
2447. H. J. Luff, 7, Thanet-place, Temple-bar—Attacking hostile bodies, &c.
2448. T. F. Calard, Paris—Bedsteads.
2449. E. Belmer, 8, Macclesfield-street, City-road—Warming apparatus.

Dated 20th November, 1854.

2450. J. Cumming, Glasgow—Looms.
2452. R. Reefe, Trim, Ireland—Dressing flour.
2453. P. A. Dulaurens and M. A. Laubry, Paris—Glove fastenings.
2454. W. B. Adams, 1, Adam-street, Adelphi—Projectiles and projectile weapons.

Dated 21st November, 1854.

2456. T. Craig and A. Daaiels, Manchester—Railway signals.
2457. R. Knight, 9, Charterhouse-square—Testing iron as to its capacity for receiving magnetism.
2458. F. Russell, Massachusetts—Mowing-machine.
2459. W. Beasley, Smethwick—Gun-barrels.
2460. A. Tylor, Warwick-lane, Newgate-street—Crimping-machines.
2461. E. Hunt, Glasgow—Screw-propellers.
2462. W. L. Thomas, Anderton, Devon—Projectiles and gun-wads.

Dated 22nd November, 1854.

2463. J. B. Bagary, Paris—Sawing apparatus.
2464. R. Terrett, Hercules-buildings, Lambeth — Knife-cleaning machine.
2465. J. H. Johnson, 47, Lincoln's-inn-fields—Piled goods. (A communication.)
2466. J. H. Johnson, 47, Lincoln's-inn-fields—Incrustation of steam-boilers. (A communication.)
2467. R. Gibson, Hunslet—Carding machinery. (A communication.)
2468. C. Gibson, Draycott, Derby—Brick and tile making machinery.

Dated 23rd November, 1854.

2469. W. Hurst, Salford—Railway-chairs.
2470. J. Wright and J. Walmsley, Alfred-place, Newington-causeway—Bedsteads.
2471. W. A. Vérel, Macduff, N. B.—Grinding bones.
2472. E. Eaborn and M. Robinson, and J. Kendrick, Birmingham—Apparatus for holding hats in public assemblies.
2474. G. Collier, Halifax—Mohair plush.
2475. G. Collier, Halifax—Pile fabrics.
2476. S. Shaw, Plaistow—Marking metal plates, and new template.
2477. J. B. Hellier, Schelestadt, France—Spinning machinery.
2478. C. W. Ramie, Jersey—Razor-strops.
2479. H. J. Duvivier and H. Chaudet, Paris—Treating gutta-percha.
2480. E. Edlund, Stockholm—Electro-magnetic telegraph apparatus.

Dated 24th November, 1854.

2481. S. A. Carpenter, Birmingham—Buckle. (A communication.)
2483. R. Cunliffe, Accrington—Brick and tile making machinery.
2484. R. William and D. Mills, Blackburn—Looms.
2485. J. Hartley, Sunderland—Perforated glass.
2486. C. M. T. du Motay, Paris—Treating soap.
2487. W. Ely, 38, Broad-street, Golden-square — Ball-cartridges.
2488. J. D. M. Stirling, Blackgrange, Clackmannan—Metallic tubes.
2489. H. Bessemer, Old St. Pancras-road—Projectiles and projectile weapons.
2490. T. De la Rue, Bunhill-row—Compositions for printing-rollers.

Dated 25th November, 1854.

2493. J. Henderson, Lasswade, Midlothian—Carpets.

Dated 27th November, 1854.

2497. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Inkstands. (A communication.)
2499. F. Delacour, Paris—Fire-screens.
2501. J. Crofts and W. Cartwright, Birmingham—Projectile.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2443. G. T. Bousfield, 8, Sussex-place, Brixton—Wrought-iron carriage and other wheels and pulleys.—17th November, 1854.
2444. W. Coulson, Fetter-lane—Machinery for morticing, tenoning, and boring.—17th November, 1854.

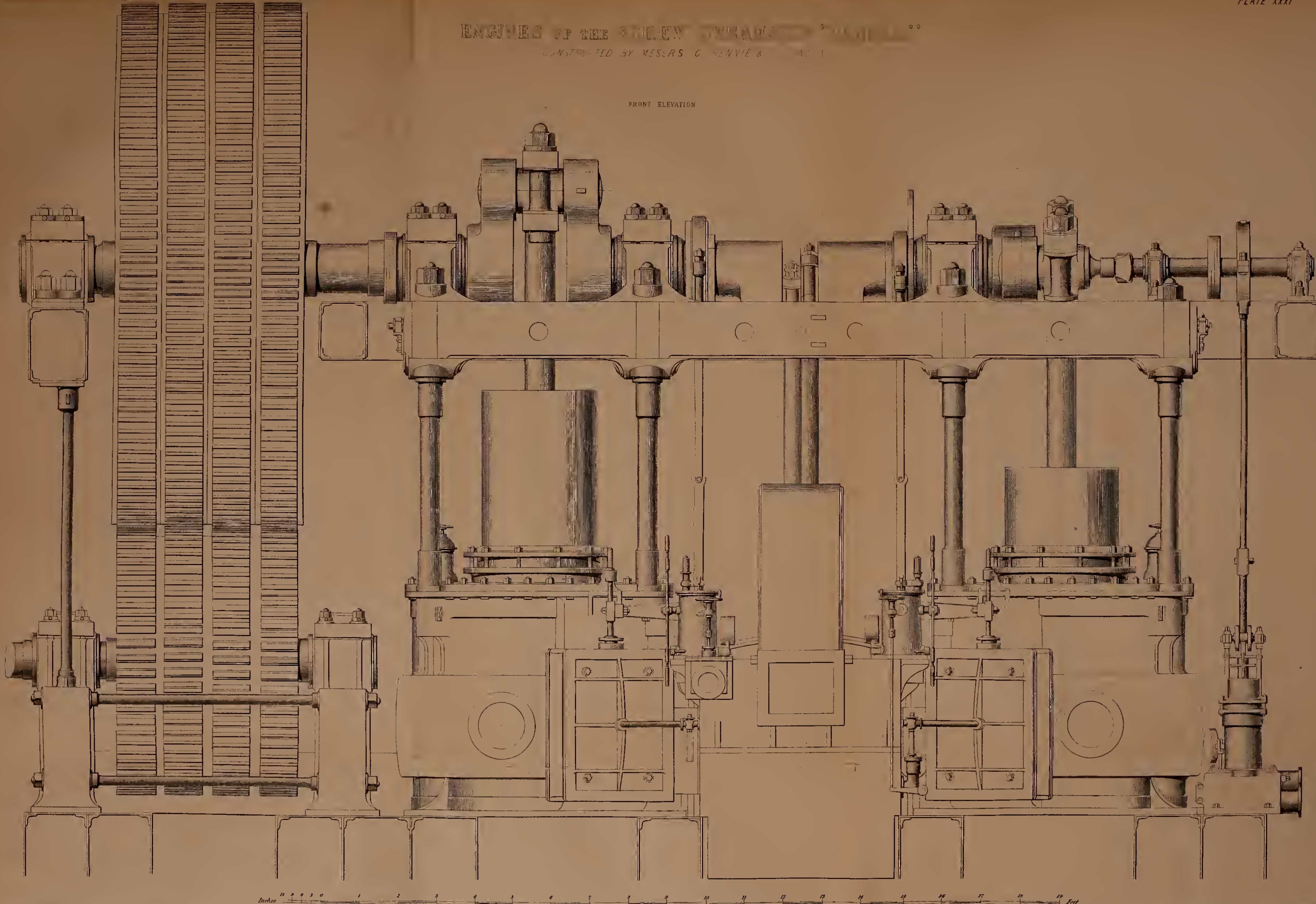
DESIGNS FOR ARTICLES OF UTILITY.

1854.
Nov. 18, 3658. George Henry Wain, Britannia-terrace, Haigh-street, Liverpool, "Wain's improved pulley-block."
„ 3659. Samuel Bentley, Birmingham, "Elbow for gas, water, and other pipes."
„ 3660. William James Page and Edward Joseph Page, Kennington-common, "Improved cricket-bat handle."
„ 3661. Broehier Père et Fils, Grenoble, France, "Gloves."
Nov. 27, 3662. Smith and Ashby, Stamford, Lincolnshire—"Chaff-cutting engine frame."
„ 3663. James Grove, 11, Icknield-street west, Birmingham—"The Alma chess and draught-board, case, and instructions."
„ 3664. Twigg and Silvester, Powell-street, Birmingham—"Settings for centres of buttons and similar dress ornaments."
Nov. 29, 3665. John Wren, 232, Tottenham-court-road, "Self-acting invalid iron chair-bedstead."
„ 30, 3666. Edm. Brown Bishop Wren, 232, Tottenham-court-road, "Portable bedstead."
Dec. 1, 3667. Christian Wemtraud, Jun., Offenbach, and 4, King-street, Cheapside, "Improved fastenings for porte-monnaies, cigar-cases, and other similar articles."
„ 7, 3668, Theodore Jones, 17, Clement's-lane, "The turnout bedstead."
„ 9, 3669, William Collinson, Liverpool, and Henry Penketh Mather, Stafford, "An improved tongued elastic boot."

ENGINES OF THE SCREW STEAMSHIP "[illegible]"

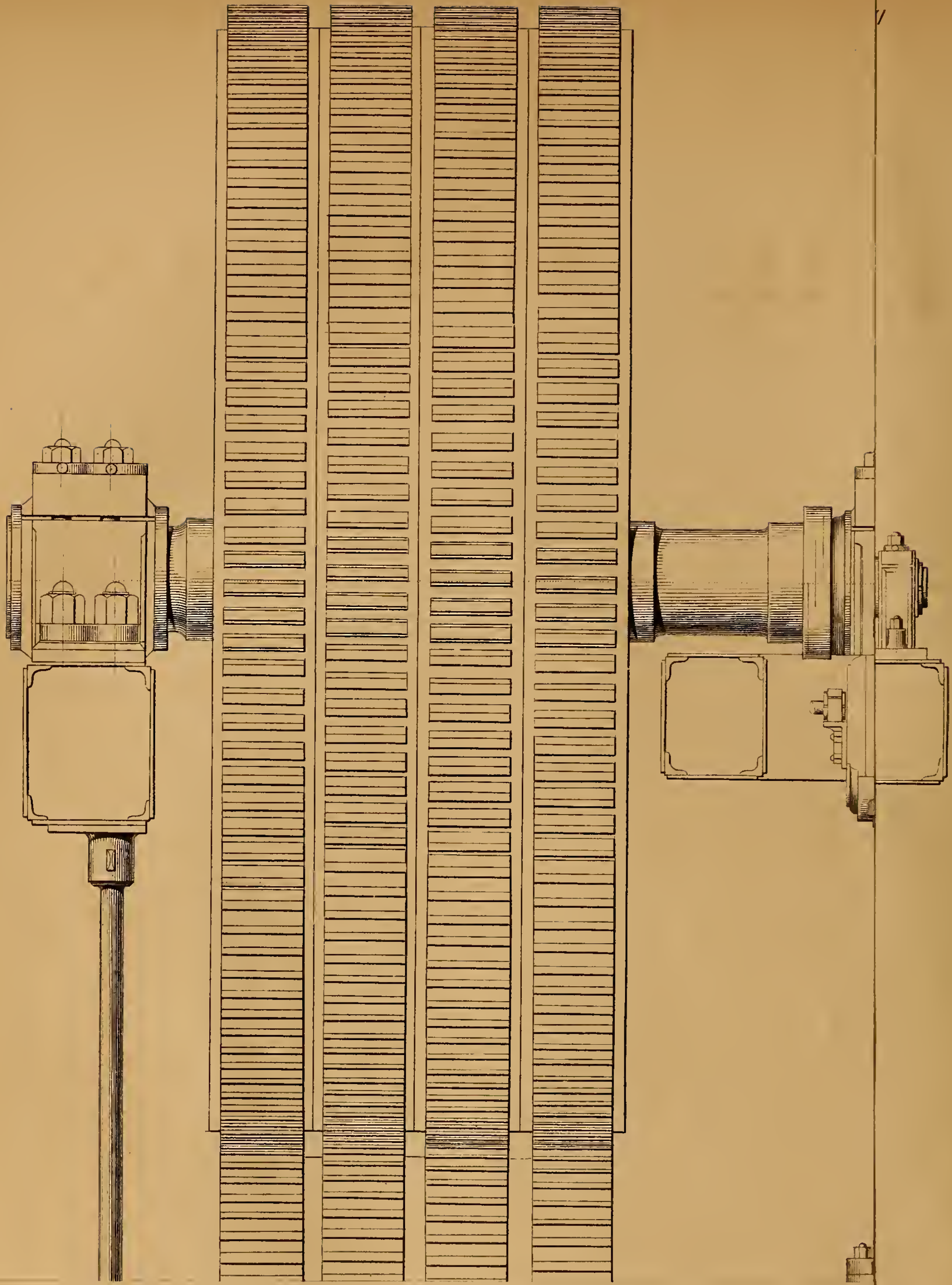
CONSTRUCTED BY MESSRS G. RENNIE & [illegible]

FRONT ELEVATION



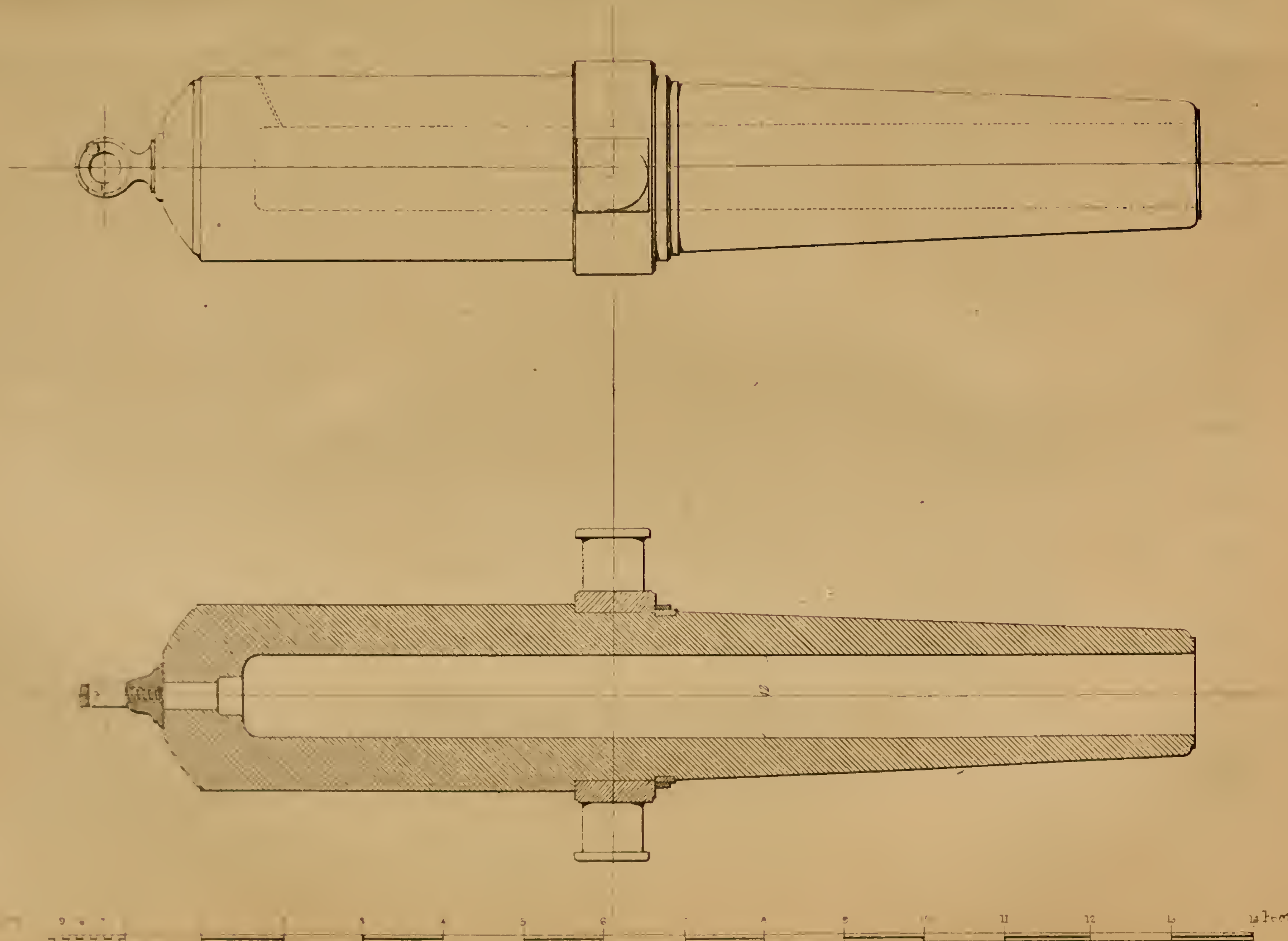
[illegible] Del[t]

M. [illegible] 20 Paternoster Row, [illegible]



MALLEABLE IRON GUN FOR THE UNITED STATES STEAM FRIGATE "PRINCETON."

Forged by the Mersey Steel and Iron Company & bored turned and fitted
by Messrs Fawcett, Preston & C° Liverpool
Proved May 8th 1845.



THE ARTIZAN.

No. CXLV.—Vol. XIII.—FEBRUARY 1st, 1855.

ENGINEERING BLUNDERS OF THE WAR.

The disgraceful mismanagement and utter incapacity of our military authorities in carrying on the war is now made obvious even to the most careless observer. With heroic soldiers and an unlimited command of money, we have succeeded in doing nothing except in making the impotency of our efforts transparent to all the world, and in annihilating, by starvation, hardship, and disease, those gallant troops which the enemy could not disable or dispirit. While all this is being done, the nation has the consciousness that it has thousands of men quite equal to the present emergency. Not only have we the bravest troops in the world, but we have the best men of business, the ablest engineers, and the most abundant resources; and it needs nothing else except to lay our naval and military authorities to the one side altogether, and to select men of business and of engineering talent who are equal to the work which is to be done, to reverse instantly all our disasters, and to perform achievements such as the world has never before seen or even imagined. All Government business is done badly, slowly, and expensively; it is choked by the solemn inanities of official etiquette, and in any work implying competition it is sure to be driven from the field. Now, war is pre-eminently a work of competition: it is a work, moreover, which requires to be carried on with electric celerity—with a perspicacious forecast of impending events, and with the power of combining all the requisite movements or arrangements into one homogeneous scheme. What but failure and ignominy can ensue when war is undertaken without any competent or accredited head to preside over the multitudinous operations which require to be carried on?—when departments have conflicting jurisdictions—are without a business machinery that would not disgrace the most common manufactory—and are in a dead-lock with one another? One obvious expedient of amelioration is, to appoint a proper War Minister, who will be responsible to the nation, and who will have dictatorial power over the whole of the naval and military departments. But this step of improvement is not sufficient; nor would it enable the energy and capacity which are sown broadcast through the land, to be recruited in the service of the State in the present emergency. It might, perhaps, enable our management of military affairs to be equal to that of other nations; but that ought not now to satisfy us, and the object should be to make us as superior to other nations in military affairs as we already are in commerce and manufactures. To enable this result to be realised, we must no longer hand over our wars to be done by sleepy and antiquated officials, but we must get them *done by contract*, just as any other work is done that we wish to have executed cheaply and well. The men who bridged the Menai Straits with a tube of iron—who, in a few months, erected the Crystal Palace, and who are daily performing tasks which would be accounted prodigies in other nations—these are the men to whom should be confided the difficult tasks of war; and these, we may add, are the men, and the only men, who are feared by the Emperor of Russia. What does he care for antiquated generals, who make the operations of the Peninsular war their models for the present day—as if no steam-vessels, electric telegraphs, and the thousand other marvels of modern science, had since been invented? And what does he care for the bits of juvenile aristocracy, as ignorant as presumptuous and exacting, who, on the strength of a red coat and a family-tree, pretend to lead our armies to victory? Our enemy knows well what value is to be attached to the anile pedantry of our old officers, and the exquisite shallowness of our young ones; and up to the present time they have been the best friend he has had, for by their mismanagement they have succeeded in working the destruction of our army—a task which the sword of our enemy could not perform. Our army in the Crimea is well-nigh extinct as an efficient force. With the sea open to it—with unlimited sources of supply and unlimited means of transport—the soldiers have been allowed to run short both of food and ammunition; they have been left without houses or proper clothes to shield them from the inclemency of the weather, and have been stricken down by disease from hardship and over-work. Their blood lies at the door of those who have been the acting and responsible parties in this mismanaged work; but we are all to blame in suffering such incapables to remain a day longer in power after their incapacity had been fully proved.

What, then, is to be done? We answer—Put out the war to be done by contract. Let one man, for a given sum, undertake to capture Anapa—let another contract, for a given sum, to sweep the Danube with a flotilla of gun-boats—let others do the same thing on the rivers Boug and Dneiper, so as to cut asunder the provinces of Russia and intercept the march of detachments—let another contractor undertake to cut off the Crimea from Russia, by establishing gun-boats on each side of the isthmus of Perekop, and sweeping the putrid sea—let another undertake the capture of Odessa. We want these things to be all undertaken, and undertaken *simultaneously*. They will require to be done before we can make much impression on Russia. The Government cannot undertake them, as it has its hands too full with Sebastopol; and responsible parties *can* be found to undertake them, whose names will carry every assurance that they will execute what they undertake. This, however, though no doubt much more than the Government could accomplish, is not by any means sufficient. We want to operate in the Baltic as well as in the Euxine. We want to capture Helsingfors, Sweaborg, Revel, and Cronstadt; and if the work be advertised as ready to be contracted for, the men will very speedily present themselves who will undertake its accomplishment. All kinds of new devices will be brought into play. Expedients which would never occur to the official mind will be brought into prompt and successful operation; and tasks from which octogenarian generals and admirals would recoil in despair, will be executed by the aid of contrivances, not formed on the feeble model of the Peninsular campaigns, but competent to the work, and pointed with irresistible power. The whole art of war resolves itself into a right use of gunpowder. That is the impelling power, and we only require to have enough of it, and to direct its action skilfully. It is not by men's muscles that wars should now be fought, but by their intelligence in directing upon the enemy such a force of gunpowder as will completely overwhelm them. The days of pop-guns are over: these must be the days of volcanos—a truth which no military authority appears to have yet discerned. It is quite impossible that we should succeed in this war, or come out of it with credit, without calling into free exercise the talents of our engineers, and inviting the energy and mechanical science of the country to exhibit themselves in this new field. Archimedes by his single arm arrested the downfal of Syracuse, and became the terror of the Romans, not by practising the orthodox expedients of warfare, which they understood better than he did, but by contriving new expedients which confounded them by their power and novelty, and against which they were not prepared with any efficient protection. If we proceed in the old military routine, we can have no eminent advantage over the Emperor of Russia, for he understands it quite as well as we do—perhaps better, and in men, at least, has inexhaustible resources. But if we let out against him our mechanical irregulars, his doom is sealed, and we need have no apprehension of the result, or of that result being speedily attained. There is no means, however, of doing this but by contracting for the several portions of the war with men equal to the responsibility, and who will allow neither aristocratic pomp nor military traditions to interfere with the direct and effectual execution of the work. Let the contractors hire their own workmen wherever they can find them—and they *will* be able to find them when the Government could not.

DEATH OF MR. EDWARD BOURNE.

Mr. Edward Bourne, Secretary of the African Steam Navigation Company, died of cholera, at Constantinople, on the 8th of January, after an illness of fifteen hours.

Mr. Edward Bourne was the cousin and early and attached friend of Mr. John Bourne, C.E., by whom this Journal was established in 1843; and his sudden and premature decease has plunged into the deepest affliction a wide circle of friends, by whom he was beloved with an ardour and unanimity which could only have been inspired by a rare combination of estimable qualities. With a large measure of the talent for which his family has been remarkable, he united a greater versatility—a more refined taste—and a larger measure of natural grace and vivacity, than any other member of it has displayed. But his main claims to admiration rest upon more solid distinctions than these:—upon a transparency and loftiness of character which both inspired and justified the most implicit confidence in his honour, truthfulness, and magnanimity—and upon a warmth and steadiness of affection which in some cases swelled into the highest emotions of friendship, and in all cases diffused over his life and conduct the sunny hues of his own sweet benevolence. Many have passed away more eminent in the world's eye—more distinguished for great deeds, for commanding talents, or for remarkable attainments; but few have ever left a more perfect impress of a beautiful and affectionate character than he who is the subject of this notice, and who was

"The soul of honour and the mould of form."

Mr. Edward Bourne was born in the year 1819, and was the youngest son of the late Frederick Bourne, Esq., of Terenure, near Dublin—the principal coadjutor of the late Captain Bourne in the establishment of the Peninsular Company. He received his education in Ireland, principally at the school of Mr. Eaton, near Mullingar; and at the age of seventeen he was sent to her Majesty's Dockyard at Pembroke, and accompanied the master shipwright, Mr. Hawkes, shortly afterwards to Devonport, to which place he was about this time transferred. At the age of nineteen, Mr. Bourne accompanied his cousin, Mr. John Bourne, C.E., to Greenock, and entered the building-yard of Messrs. John Scott and Sons, who at this time were completing the *Tagus* and other of the original vessels of the Peninsular Company's fleet. His father's declining health recalled Mr. Bourne to Ireland, to take part in the management of his affairs, which he continued to do for some years with much success; and on the establishment of the African Steam Company, his cousin, Mr. Hartley, wished him to become the Secretary of that Company, which he accordingly did; and he continued to hold this office up to the time of his death.

In the art of shipbuilding Mr. Bourne attained to a high measure of proficiency, and here his fine taste had an opportunity for displaying itself in the beauty of the models he produced. With all the details, whether mechanical or commercial, of the art of locomotion by land and by water, Mr. Bourne was quite familiar, and in every department of it he had at different times manifested a high measure of ability. He was a fine draughtsman—a good musician, and there was an innate tact and grace about him which enabled him to do well anything that he undertook. His personal appearance quite corresponded with his moral qualities, and the lustre of the gem was not obscured by any faults of the setting. All these high gifts, however, have been brought to nought by the inexorable hand of death; and the only manifestation of their existence that is now to be found is the inconsolable affliction of surviving friends, whose regrets are as boundless as their love.

Mr. Bourne was married, in 1845, to Hannah, daughter of P. Eckersley, Esq., of Manchester, to whom he was tenderly attached, and who, with two infant children, survive to mourn his decease.

PRACTICAL PAPERS.—No. II.

ON DESIGNING MARINE WORK.

In referring to the "shafting" of a screw-steamer fitted with geared oscillating engines, it is convenient to divide the whole system thus:—there is the engine-shaft worked by the pistons, and working the air-pumps, &c.; there is the spur-shaft, the pinion-shaft, and screw-shafts; the spur-shaft transmitting the power developed in the cylinders to the pinion-shaft by a crank on the fore-end and wheel on the after-end, which in turn drives the screw-shafts. In our last notice of this subject, we made provision for carrying this system (supposing it placed in an iron ship) as far as the pinion-shaft: we now proceed to the shafting plan, the use of which is to instruct the shipbuilder where to place supports for the bearings of the screw-shafts; how high to make them, and what width; what clearance to allow round the pedestals, or, as we shall term them, "bearings;" and what hand-holes or spaces to leave for putting in the bolts necessary for firmly securing these bearings: also to show the minimum room for the screw-alley or tunnel (*the wrought-iron casing which surrounds the machinery — to prevent the contact of cargo or coals, and to afford easy access to the bearings and stern-bush*); also to indicate the frame on which the end of the stern-pipe will come, and what diameter the stern-post must be bored to, for fixing the end of the stern-bush in. To the engineer its use is to show him on what centre line to lay his shafts, and to enable him to construct the details of the means of transmitting the motion of the pinion to the screw—namely, the shafts, their couplings, their bearings, and the stern-bush. To commence this plan, it is necessary for the engineer to have a drawing from the shipbuilder, showing the length of the ship from the centre line of the engines to the stern-post, including thus part of the ship-drawing, and showing also the space for the propeller and outer stern-post. The centre line of engines is a main point to work from; and if placed on a frame, accurate dimensions can be got by calculation, as the frames are equi-distant. Numerous sections of the vessel are useful, and quite necessary at the stern part, where it is supposed that the stern-bush will terminate. It will now be requisite to determine the dimensions of the propeller. This question is a compound one—economy and science—and so much depends upon the "for whom" and "for what" is the vessel to be constructed, that we shall only generally remark, that it is useful to bear in mind, when originating or altering the dimensions of a propeller, that the angle of the blade depends upon the pitch and diameter. With the pitch constant, the greater the diameter, the less the angle.

In illustration of this, suppose the line A″ B″ (Fig. 1) to represent the constant pitch; if B A, B A″ and B A‴ represent the circumference described by the blade of the screw in one revolution, which lengths of course vary as the diameters, the angles of screws of the same pitch, A‴B‴, but various diameters, will be found by joining the point B to B′, B″, B‴. With the pitch and diameter constant, the surface of the propeller-blades varies as the length of the screw. The efficiency of the screw depends on the position of this surface. There will be the same

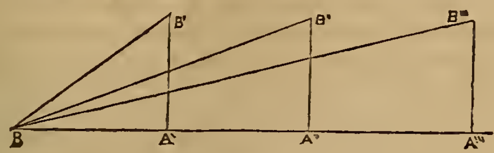


Fig. 1.

resistance to a screw of given length and pitch, but various diameters—because, as these increase, and consequently the surface, the angle or position of the blade inclines more to a plane at right angles with the vertical plane of the screw-shaft. Fine-angled screws give the best results, and appear to be most extensively used at present. In illustration of the advantage of the fine angle by the *reduct. ad absurd.* method, we may remark that, with the screw-blade at an angle of one second, though no appreciable propelling force would be developed by its revolution, yet no positive resistance, such as would be caused by a blade at an angle of 89° 59′ 59″, would arise. Thus, in our diagram (Fig. 2) the long dotted line represents the centre line of shaft; the

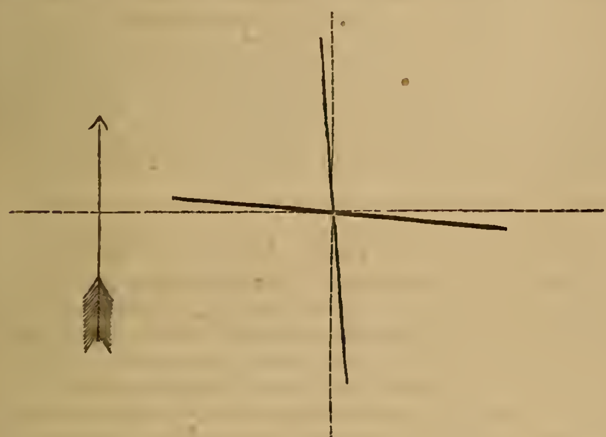


Fig. 2.

short one cuts it at right angles, and from the point or line of intersection we set off the dark line at an angle of 89° 59′ 59″: so, with the line at 1″, the action of the shaft turning the blades in the direction of the arrow, the result is obvious. However, we must suppose the diameter and length of screw to be given to enable us to proceed with our plan. At what height, then, must we instruct the shipbuilder to prepare a berth for the end of the stern-pipe? In our last paper we explained the method of ascertaining the height and inclination of shafts. Using this method, then, we set off on the stern-post the semi-diameter of the screw, plus 3 inches, to allow plenty of clearance between the extremity of the blades and the upper side of the keel. Then, on the centre line of engines, from the centre of shaft, we measure off the distance from centre to centre of wheel and pinion, and by joining these two points we have the centre line of shafting. Setting this line on the sheer plan and sections sent by the shipbuilder, we find, by examining the after sections, that one nearest the stern-post, which has, at the height indicated by the centre line, sufficient width to allow a man to get at the stuffing-box of the stern-pipe gland. We select the frame nearest the stern-post, evidently to shorten the stern-pipe as much as possible. A long stern-pipe has the advantage of diffusing the strain of the propeller-shaft over more frames; but there is more difficulty in casting, boring, and turning a pipe of 30 feet in length, than one of 20 or 15 feet. After fixing this point, we can arrange the shafts in convenient lengths. And then arises the vexed question of what form of propeller to use?—whether it shall be overhung?—must an outside bearing be provided?—is it best to make it lift altogether out of the water, when the ship can advantageously be put under canvass alone?—or shall it be arranged so as to revolve freely when disconnected from the engines?—or shall it be be-Griffithsed, or be-Maudslayed, or be-patented in any way? Our object, at present, is merely to show the principle of the construction of this plan; so we will reserve the discussion of these questions, and suppose it decided that the screw shall be fixed permanently on the end-shaft, and have an outside bearing, as recommended at page 159 in the number for July 1850.

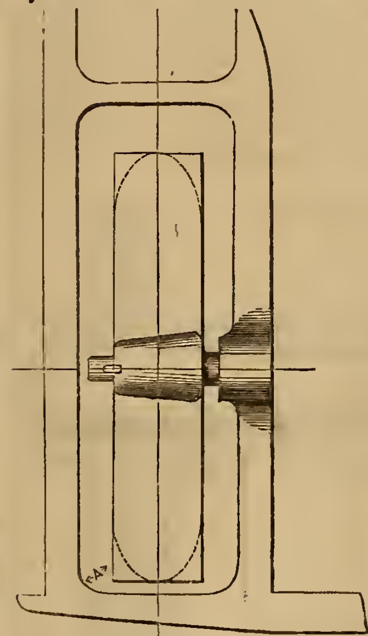


Fig. 3.

Producing the centre line of shaft to the outer stern-post, we set off the width of the screw, about the centre of the space left by the shipbuilder for its reception; then sketching in a rectangle formed by the diameter and width of screw (Fig. 3), we show the necessary clearance. Supposing the stern-posts to be run into the keel with a radius as at A, Fig. 3, the centre of this radius must be outside the width of the screw; for though the end view of the propeller-blade would be curved, as shown by the dotted lines if accurately delineated, yet every point in it travels in a vertical plane at right angles to the shaft in the direction of the arrows shown in plan, Fig. 4; and if the curve was described from a point inside the width, the blade would probably touch at the point: at all events, the clearance of 3 inches (allowed under the lower edge of it) would be diminished. There is usually plenty of room above the upper half of the propeller; but as a stay is sometimes carried across the space to connect the stern-posts, it is well to make sure that it is placed high enough. We particularly recommend plenty of room to be left on all sides of the screw, as it has been observed that when the

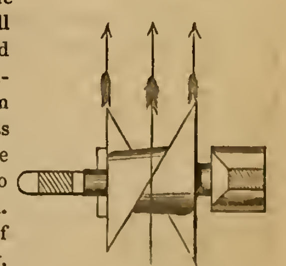


Fig. 4.

blades revolve close to the stern-post, a tremulous motion is caused: the water does not impinge freely on the screw when passing the post, and though the time of passing is in some cases hardly appreciable, yet the repetition produces the evil; a slight loss at every revolution becomes serious when estimated in hours or minutes. In our number for August 1852, we gave the performance, in a tabulated form, of the *Weaver*, a successful screw-tender of 20-horse power by Messrs. Fawcett, of Liverpool. In this boat, the propeller made 332 revolutions per minute; and from 70 to 100 revolutions are often made by propellers fitted to large engines and vessels. The outside bearing is often limited as to its diameter by the size of the bored aperture in the screw. We think this bearing should be very large—two might be provided, as shown in our sketch—feathers to drive the screw being fitted on to the shaft, and collars and a cotter (to take the thrust) fitted into the boss and shaft, as shown. If this form of propeller-boss was to be used, we should leave an opening in the after stern-post large enough to allow a heavy "tupping" apparatus to be employed when the screw was to be removed, as shown, Fig. 5.

The stern-pipe is a source of trouble and anxiety in many cases to marine engineers; and in a future paper we may give the details of another arrangement to prevent the rapid wear at this point. We must, however, attend to the shipbuilder's share of the plan at present, and having got the end length of shaft in position, we sketch in the spur and pinion shafts, the bearings for which have been already fixed. The thrust bearing-beam requires the next consideration. In the case of a screw fixed permanently on the shaft, whether provided with an outside bearing or not, the best position for the thrust-pedestal is on the shaft immediately following the pinion-shaft. For these reasons, we are enabled to dispense with collars on the sides of the screw-shaft journals, though it is perhaps advisable to turn light ones on the pinion-shaft, to keep it in position when disconnected from the rest of the propeller-shafts: it also obviates the necessity of providing for the thrust on outside bearing on the after stern-post, when backing the ship, which would have to be "schemed" for if the thrust-bearing was placed on the fore-beam for supporting the pinion in the engine-room, which would otherwise be an eligible position for it, though

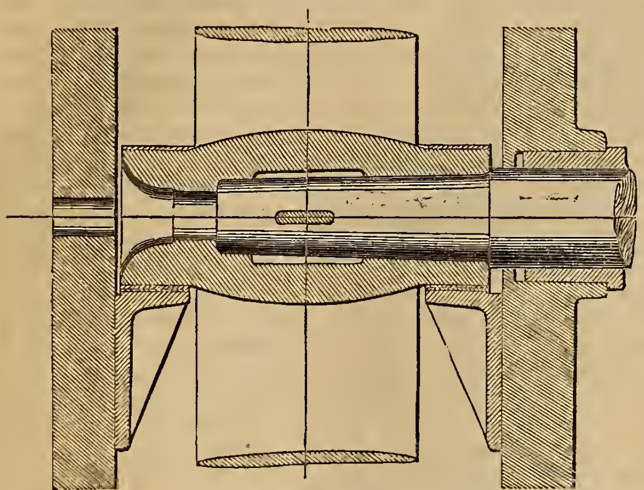


Fig. 5.

here it would be immediately subject to the lateral stress of the wheels, and to the friction caused by the weight of the pinion. Another reason for placing it near the engine bulkhead is, that it requires more attention than any of the other bearings, and the tunnel, or screw-alley, is, if there is any difference in size, at this point, the most roomy. As the thrust of the screw is passed through this bearing, the beams for the rest of the shafting are simply to support the pedestals vertically. An eminent northern shipbuilder has introduced a plan of running up plates from the tunnel-bottom, rivetted to one side of the tunnel only, and just projecting far enough across to afford a base for the soles of the pedestals. This is evidently all that is necessary for the bearings, which only require to be maintained vertically true; but the thrust-bearing should be placed on a box-beam running across the tunnel; or, if the convenience of passing through the tunnel, afforded by the plan of carrying these supports partially across it, be considered important, stiff plates and angle-irons must be carried fore and aft in the tunnel, and strongly secured to the frames of the ship or bottom of tunnel; otherwise a vibration will ensue that will shake the whole system. Having decided its position, we must leave room for men to disconnect the pinion-shaft when the vessel is under canvass, or if, when short-handed in dock, it is desirable to turn the engines by hand. A form which obtains extensive adoption is the cast-iron disc-coupling, having a strong boss formed on the back of it. Feathers are let into the shaft to drive from, and strong pins run through the boss, taking the thrust and pull. The couplings are bolted together—the bolts transmitting the driving power from one shaft to the next. By removing the bolts, which in the disconnecting coupling are best made with a taper of 1 in 12, the screw can revolve freely. The bolts, when once started, require no driving, as they would if made parallel.

Before proceeding to the detail of the stern-bush, bearings, couplings, and shafts, we may now remark that, having placed the end-length of propeller-shafts, and indicated position of stern-pipe, thrust bearing and pinion shaft, we divide the intermediate space of the vessel into convenient lengths for the remaining shafts. One of 8 inches diameter and 30 feet long can be made, swelled in the centre, increasing in diameter about one-sixteenth of an inch per foot in long shafts. An 11½ may be 30 feet long, and, in the present advanced state of our forges, we have no doubt longer lengths could be safely produced; but, as a 30-foot shaft is not a very accommodating piece of material to hand down hatchways, in case of repairs, or even when first laid in the ship, we would limit shafts, as to length, to this dimension. Placing, then, the supports, if possible, between frames, so that dimensions can easily be taken, and making them in width to correspond to the distance between two frames (which will generally be found enough), we fix the height by the method before given, if there is an inclination in the shafting, either from the stern-post to the engines, or from the engines downwards to the stern-post. If the shafts are level, we figure the top of the beams, the same as the centre of stern-post, less distance between centre of pedestal, brass, and sole, showing the width of sole to ensure clearance, and hand-holes for getting at the pedestal-bolts. The tunnel can then be sketched in; its maximum size may be left to the shipbuilder's feeling for the engineers who eventually take charge of the boat: its minimum must be regulated by considering what room is required to remove any of the shafts, and what height above the bearings. These dimensions, of course, depend upon the form of couplings and bearings proposed, varying according to the judgment of different manufacturers. We strongly recommend, however, that all steamers of importance, as to size, be fitted with *strong* water-tight and roomy tunnels. We would not be quite so luxurious as the designers of the *Himalaya*, but recommend the above properties to be embodied in the construction of the tunnel, as conducing, in case of accident, to the safety of the ship, and depriving negligent engineers of any pretence to excuse a want of attention to the *exigeants* inhabitants thereof.

VISIT TO THE MERSEY FORGE, LIVERPOOL.

In a recent article we noticed the capabilities of Liverpool to supply the country, in its present need, with offensive or defensive hardware. Our foundries and forges are the sources from whence these supplies are mainly to be drawn. Our ships are bound together with iron, propelled by iron, and, if not manned, are defended at least by iron. Though Government favours have been sparingly given to the engineers and shipbuilders on the Mersey, they have been well supported by private parties, in executing which in the excellent manner they have hitherto done, they have been materially aided by the Mersey Steel and Iron Company. "The consumption of iron in Liverpool itself last year altogether has been carefully estimated at 58,000 tons." We quote from the "Commerce of Liverpool," by Mr. Braithwaite Poole, written in 1853; and it must be borne in mind that the large quantity of iron manufactured there is not divided amongst a swarm of small factories, but is mainly absorbed by the extensive establishments named in our last number; and thus, by the concentration of much skilled labour under the direction of a few eminent firms, Liverpool can command the best orders. A town crowded with small workshops, though each belongs to men of skill and industry, is rather a great manufacturing place, than a place where great things are manufactured. A school full of industrious lads is not a learned assembly: if each small capability could be estimated, and the whole added together, the total would be imposing enough; but it is not the small powers added together that is wanted—it is the capability of the unit; and so, though Liverpool has but one forge, she can compete with any town in England in the production of wrought-iron work. We are enabled, by the courtesy of the proprietors, to lay before our readers a description of these works: we shall accompany a few tons of iron through them, and, as spectators, describe the burning, fiery furnaces into which our companion enters, the depressed condition in which he makes his exit from them, and the ponderous concussive means taken to restore him to strength, and shall present him at the Forge-gates ready to drive our steamers, crush our sugar-canes, hoist our ships, or fight our battles, enabled so to do by the very warm and pressing attentions of the Mersey Steel and Iron Company.

These works are situate at the south end of Liverpool, fronting the river from which they take their name. They consist of two large enclosed buildings: the Forge (or Old Works) is nearest to the river; the Upper, or New Works, lately designed and erected on the plans of the manager, Mr. William Clay, which we will describe first, extend over upwards of 6,000 yards of land, and here is performed the greatest part of the puddling and rolling. They are surrounded by a high brick wall, light sheds protecting the men from wind and rain: from the nature of the machinery used, no heavy upper work is required, though it is necessary to have massive foundations. The first noticeable point on the exterior is a succession of semicircular openings at the top of the north wall, about fourteen feet wide; these are for lighting and ventilating that part of the interior taken up by the puddling-furnaces, and keep the roof high enough, at the same time being stronger than equal rectangular spaces and columns. The land on which the works stand inclines towards the river, and lies between a high level and a low level cart-road. One advantage of this position is, that the scrap, pigs, and coal can be taken in at the top side, whence they pass in succession to the furnaces, hammers, rolls, and shears; cartage through the works being thus rendered unnecessary. When the British Association was in Liverpool some little time back, when St. George's Hall was opened, many of the members visited these works, as notable of their kind. We doubt not that the scrap-heap suggested considerably more to the minds of those learned gentlemen, than to the furnace-men who commonly deal with it. The assemblage of scrap is as varied in shape, quality, and disposition, as the Association itself. Italian irons and intermediate shafts, locks, donkeys' shoes and tackles, chain-cables and coffee-mills, smoke-jacks, coach-work and saddlers' work, and gas-fittings—anything iron, that a marine-store dealer or a marine engineer can advantageously dispose of at £5 per ton—is to be found here. By the side of these ill-conditioned scraps, the "pigs," who have just made their appearance from the smelting-furnaces, look quite respectable; little difference, however, is made in fitting them for active service: the first require the hardest blows perhaps, but both are renewed in the furnaces, and fashioned to lead a new life by the rolls and hammers in much the same way. Surrounded by scrap, is a strong pair of shears, worked by an engine consisting of two cylinders 14 inches diameter and 2 feet stroke. It is useless to estimate the force of these forge-engines in horse-power: the strains upon the machinery are at times so sudden and severe, that all the parts are made exceedingly strong; the pressure of steam is increased if the cylinder at some given pressure is not large enough for some given work, and so the horse-power is varied to meet emergencies: however, this is called a 20-horse engine; so another, a beam-engine, 36″ cylinder, 6-feet stroke, with stamper-valves, and made from Staffordshire patterns, is called a 100-horse; and another, an 80-horse, 24″ cylinder and 4 feet 4 inches stroke, running at 277 feet per minute, with 45 lbs. steam. Of course, we cannot here enter into the question of the best method of estimating the power of these engines, which, it may be remarked, are all non-condensing. Folio after folio has been written on the subject, and yet every man wanting an engine applies his own method of calculating the requisite dimensions for it; and forgemen should pay more attention to the diameter of cylinder and stroke proposed for them by their engineer than to the nominal power quoted, as, in this latter particular, the most tender professional consciences can be most variously accommodated. To return to our shears:—they have a semi-Procrustean duty to perform; they object to any piece of scrap longer than 18 inches or wider than 7 inches, but take no notice of any piece below these dimensions. The reason is this: to facilitate the conveyance of the scrap to the furnace, it is piled on light boards, 18 inches long by 7 to 12 inches wide, and 7 inches high, in the piling and sorting house, whence it is taken and carefully put into the furnace; the mass gradually heats and settles down, and when withdrawn to go to the hammer or rolls, has a regular formation. The size of these piles varies with the work in course of execution, of course, the shears reducing the scrap to suitable dimensions for making them. A mere shed would be quite sufficient for a sorting and piling house; but as the manager found it advisable to have a large tank holding about 20,000 gallons of water, at a sufficient height above the boilers (to supply the engines above enumerated), so that they might be filled when steam was down or very low, substantial walls were run up to support it, and the space enclosed used for the purpose of sorting and piling. The scrap-shears are very strong—they easily dispose of bars of 2½ inches diameter; there is also a pair of shears able to cut an axle 4 inches diameter; and the fly-wheel on the engine-shaft is 12 feet diameter, the section of the rim being equal to 162½ square inches, or 13 inches × 12½.

We proceed to Puddle Alley—or we may call it Puddle Street. On each side of a wide space lie the furnaces; there are thirty at present in the Upper Works. Puddle Street is not *Hansom-ly* paved; worse than wood-paving, it is laid with cast-iron plates. The blooms or blocks of puddled iron are drawn on "trawleys" (short trucks with small wheels), not on railways, but on plate-ways, to the rolls. The weight of flooring-plates, we understand, is more than 350 tons; but the ease with which the metal is dragged over them saves the expense of labourers, who would otherwise necessarily be employed to assist the furnace-men. These eighteen furnaces in Puddle Street and the adjoining neighbourhood are self-contained, and besides enjoying the Continental pleasure of continually wearing out and having their constitutions renewed, they pay the warmest attention to the boilers for supplying the engines we have before noticed.

The flame and smoke from two furnaces is led into two flues, 2 feet diameter, running through a vertical boiler 6 feet diameter and 35 high, which projects through the roof over the works, and has a short chimney, fitted with a damper, built on the top end. This plan was originated, we think, by Bamforth, and has been advanced by Nasmyth, and answers most efficiently. We have seen this plan used, and steam of 80 or 90 lbs. pressure raised; but the manager of the works at present does not find it advantageous to carry more than 45 lbs. on the safety-valve, at which pressure steam is easily raised and maintained. The lower end plate of the boiler is square, and rests on four cast columns, the corners over the columns being gusseted to the shells. There are nine boilers, and each has a feed or donkey engine attached to it. The steam-pipes and feed-pipes are connected together and appear complicated, but a little attention to the nature of their service shows that they are skilfully arranged.

The donkey-engines' cylinders are 6 inches diameter, stroke 10 inches, and work directly a 3½-inch single-acting pump. The boilers, without mountings, weigh above ten tons each. The feed-water supplied by these small engines is taken from a "hot-well," the water in which comes from the large tank over the piling-house. The waste-steam pipe from the 100-horse engine passes through it. If this tank were below the level of the suction-valve of the pump, when heated, the water would not readily follow the ram; but the efficient action of the pump is secured by gravity when the tank is placed, as in this case, some feet above the suction-valve.

The puddling-furnaces for the pig-iron have cinder bottoms, those for the scrap have sand bottoms: the pig-iron is refined for some descriptions of bar-iron. Various kinds of metal are melted together, and run into a large sheet 18 inches wide, and from 8 to 10 feet long: they are by this means introduced to each other before their acquaintance is completed in the puddling-furnace, and thus a more uniform quality of iron is produced. When the sheets are run from the refining-furnace, water is poured over them, and they contract and crack in all directions; when broken, which is easily done by a sledge-hammer, the section where the water has not penetrated is close and silvery in appearance. The pigs are worked by the squeezer and rolls; but the wrought-scrap, being tougher and harder, is worked by the hammer and rolls. The 100-horse Staffordshire engine drives the squeezer and rolls on one side, and the hammer and rolls on the other. The engine of 80-horse power is for the boiler-plate mills and shears.

The operation of puddling is sufficiently interesting to the visitor, especially if he have strong eyes; otherwise a glance into the interior of the furnace is quite enough. The pig-iron, or the refined metal, gradually melting by the action of the flame, boils up, as it were: the attendant stirs this liquid mass, in order to expose all parts fully to the fire. In this state it will form into a ball-like shape, if properly worked; and by way of illustrating this operation, suppose the fire withdrawn, the furnace cold, a layer of soot on the bottom and partly filled with snow; then begin to form a ball by rolling a lump backwards and forwards, taking care not to collect any of the soot; and by the time that a ball equal in size to the bulk of a hundred-weight of metal has been formed, an approximation to puddling has been performed. The cinder, as it is called, we compare to the soot; and it must be thoroughly driven out by the hammers and rolls to produce good iron.

From the furnaces the piles and the blooms are drawn over the cast-iron floor with ease, sometimes dripping with scoria, if we may use such a term, and passed through the rollers, or taken to the squeezer, or put under the shingling-hammers. The rolls are cast solid, and parallel grooves, corresponding to half the section of the bar to be rolled, are turned out of them: the first groove is large, to admit and draw in the rough pile, which assumes in its passage the section of the rolls: the iron is then handed over the top roll, which is revolving in the direction of the first workman. The iron becomes longer at every passage, and finally is transformed into a solid bar; at least, this is the desired end. As in glued joints, if the glue be not well squeezed out, so that the fibre of the wood can be "strained," and the particles brought close together; so with iron, if the scoria and impurities developed in it by the furnace be not thoroughly expelled, bad iron will be the consequence. A squeezer is used for the puddled iron: it consists of a strong casting of iron, flat on the face, working like a crocodile's jaw; and here the blooms can be forced into shape for the rolls: if scrap were put into it, its hardness might either break them down or stall the engine. When a lump of metal becomes fixed in the rolls, or if from some unlooked-for resistance the engine comes to a stand, the forgemen say it is "stalled." The boiler-plates are rolled by two pairs of 21-inch rolls; these are rather larger than usual, and run at about 175 feet per minute. The scrap is worked up into bars by the smaller rolls, and then laid up again to form piles or slabs for boiler-plates. The two pairs of 21-inch rolls are identical in shape, but not in quality: the first pair rough the slabs down, which are passed through and returned over the top till they fit a gauge, the upper roller being screwed down at every passage till the right thickness is given to the plates. This screwing down is not necessary with the bar-iron rolls, as the succession of grooves effect the same end, and do not require altering for any given quantity of iron after the first setting. The finishing boiler-plate rolls require a very hard face, and are subject to the most severe strains, in consequence of the metal being cooler when passed through them than when it is first roughed. After the rolling is completed, the irregular edges must be removed by the shears, which is the last operation, and about one-third of the weight as it is passed through the rolls is here taken off: and some idea of the severe treatment the iron undergoes in refining, puddling, hammering, and rolling, may be formed by the visitor when he learns that a ton of scrap will only make about 12 hundred-weight of plate or bar iron for the markets. Plates one inch thick, any length, and 18, 24, or 66 inches wide, are made here; and, by the apparently irresistible energy of a 60-ton fly-wheel, the rolls work the iron more as if they were turning out biscuit-paste than boiler-plates. The shears for these large plates are proportionately strong. Two upright frames carry a shaft on which are cast three eccentrics: cast-iron is employed for this purpose, we suppose, as it is more rigid than wrought-iron—as, for the same reason, cast-iron weigh-shafts for working the valves of large side lever-engines are often used. The throw of these eccentrics is the stroke of the blade. To shear an inch-plate, a stroke of an inch and a half would be enough; but the edge of the blade is nearer the centre of one of the end eccentric's shaft than the other, so that it may gradually cut the plate; thus the stroke is the thickness of plate + clearance + height of extreme point of one end of the blade above the other. The machine is arranged so as to make four cuts a minute; the engine runs at 32 revolutions, and drives a 6-ft. drum, the strap from which takes on to a 3-ft. drum; the shaft on which the latter is keyed has a 2-ton fly-wheel on it, and a 6-inch pinion, formed out of the solid metal, driving a 7-ft. 6-in. wheel keyed on the eccentric shaft. The advantage of using this description of shears is, that plates under 10 feet in length can be cut at one *setting*, and that the scrap is not curled in the operation. The main point of interest in this part of the works is the fly-wheel of 35 feet diameter; it is fixed on the crank-shaft of the 80-horse engine. It is made up of four castings—the rim in two parts, and the arms and centre in two more; the first weigh about 12 tons each, the latter 18 tons each—in all 60 tons. If laid down on its side in one of the principal streets in Liverpool—Bold Street, for instance—a passway of about 2 feet 6 inches only would be left at each side. The rim has, in cross section, 144 square inches. A line joining the facings of the rim would be at right angles to a line joining the facings of the centre. The halves of the centre are drawn together by two 6-inch square bars, with cotters 5″ × 2″, and further secured by hoops of wrought-iron, 6 × 5 inches, shrunk on to the boss, besides four wrought-iron hoops, shrunk on to projections cast on the wheel centre, 4 inches square. The hole for the shaft is 24 inches square, and the shaft is 21 inches square in the centre. The bearings are 18 inches diameter and 30″ in length, and are mounted, according to a plan of the managers, on friction-rollers, which appears to have answered very well. So smooth is the working of this machinery, that the visitor has little idea that 60 tons of metal is travelling before him at about 3,520 feet per minute. This weight is equal to about 800 men travelling at 13 times the usual average walking speed. It is more than three times the speed of piston of the first-class broad gauge engines, in which the piston runs at 1,000 feet per minute. The mechanical energy resident in the rim alone is 2,749,280 pounds raised one foot high (see our formula, given, page 75, Number for April, 1850), and the centrifugal force, calculated by same formula, is 144 tons; but to guard against the disaster of a break-down with a wheel of this size, the calculations were made to render it safe at 80 revolutions. The pedestals for carrying the fly-wheel shaft are massive castings about 12 feet long on the sole, bedded on masonry, which is carried down to a depth of 20 feet. These proportions, though unusually strong, have secured the bearings from heating, and there has been no trouble with them since the starting of the machinery.

In the Lower Works there are 14 furnaces, 9 hammers, and steam-engines in great plenty. Whichever way the visitor turns his eyes, he is saluted with steam and fire. Below him he finds the boilers for some of the steam-engines; above, through the roof, a conflagration appears to be commencing; but the furnaces he sees do not smoke—they "*fire*." Around him a system of steam-pipes enclose the centre of attraction for the time—one of the large hammers—as rails do in keeping the public from interrupting some popular performance of man or beast. If he be not careful as he passes the rolling-mills where the rod-iron is made, he is in danger of suffering the fate of Edward II. The enormous plates for the Baltic gun-boats are in course of manufacture at present; and as water is thrown on the glowing mass, he is startled now by an explosion, and, if near the hammer, brought up very shortly with one of the sharp splinters that are thereby thrown off. The engine-power consists of non-condensing engines — nine in number — two 16's, one 80, one 25, one 12, two 40's, and two 20's — or nine cylinders, nominally equal to 540-horse power. This seems very ample; but the annual yield of the Mersey Forge has been above 12,000 tons; and with the improved arrangements lately executed, the manager fully expects 18,000 tons to be the amount sent into the market. The yearly hammer-list shows the following weights:—They have a 25 cwt., two of 80 cwt., a 100 cwt., 120 cwt., 140 cwt., 150 cwt., 180 cwt., 190 cwt. The forge-hammer is made up of the helve, the anvil, the standards, the cam and shaft, and the braye: a gagger is used to stop the motion. The helve is a ponderous casting, set upon two standards, worked up by a cam, falling with a force due to its gravity. The cam, in the large hammers, transmits its motion to the helve through a strong bar of wrought-iron wedged into a dovetail formed in the casting (this bar is by a misnomer called the braye—it is the brayee; the cam, the brayer). As the forgings are varied in size, so the space between the hammer and the anvil-block must be increased or diminished: this can be done by altering the swage in the helve, the height of the anvil-block, the height of the gudgeons on which the helve vibrates, or by altering the "braye." The maximum stroke of the hammer depends upon the cam. To stop the hammer, a lad inserts a bar between the end of the braye and the cam; and a man, called the gagger, puts a strong strut of wood or iron between the anvil and the helve; the cam then clears the braye by the thickness of the iron previously inserted: to start again, the iron is put on the cam and the braye withdrawn. This plan, dangerous as it is, is sanctioned by long custom. "If the man slipped!" hazards the visitor. "Oh, no; he'll never slip—he never did slip"—is the gag administered to the philanthropic innovator immediately. There are no puddling-furnaces here, the iron being all prepared in the Upper Works; so the main duty is to keep the hammers supplied, in forming heavy shafting, hydraulic press-work, engine-forgings, and anything in the shape of hammered iron. There are only two mills here—a large one for rolling taper iron (Clay's Patent—see ARTIZAN for February 1850, page 27), and a small one for rod-iron.

In 1845, a large gun for the United States steam-frigate *Princeton* was forged here. Feeling a great interest in the question as to the applicability of wrought-iron as a material for ordnance, we made inquiries about this gun, and are enabled, by the courtesy of the proprietors of the Mersey Forge, and Messrs. Fawcett and Preston (by whom it was bored, turned, and fitted), to give our readers a drawing (Plate xxxii.) and the following particulars of it:—

	Feet.	In.
Length from breech to muzzle	13	0
Length of bore	12	0
Diameter	1	0

Weight of shot............ 219 lbs.

	tons.	cwt.	qrs.	lbs.
Weight previous to boring and turning	11	3	2	11
" " when finished	7	17	1	0

Proof charges, 1 of 30 lbs. powder, wad and shot.
" " 3 of 44 lbs. powder, double wad and shot.
" " 26 of 30 lbs. powder, wad and shot.

If experiments show that wrought-iron is suitable for ordnance, Liverpool having produced this gun nine years ago, has a *primâ facie* right to Government patronage. We are authorised to deny the statement in the "Mining Journal" that it burst. It is as good as ever, in Brooklyn Navy Yard, New York. Further to show the efficiency of the machinery at the Mersey Forge, we may give the weights of a few of their large forgings. They made the shafts for the *Amazon*, 17 tons; a shaft for the *Great Britain*, 16 tons; two intermediate crank-shafts for the East India Company, of about 17 tons each; and large cranks and shafts for the Halifax Royal Mail Company: indeed, some time ago, when a visitor was going through the works, the manager enumerated, then in progress, forgings for every mail company in England, besides some Government work. They have now in hand a double-throw crank-shaft, about 18 tons in weight, and have made in the last four years about forty shafts for marine engines for Messrs. Fawcetts of Liverpool alone, out of which number there has not been one failure; besides having supplied that firm, noted for its sugar-mills and sugar-making machinery, for many years with the massive forgings requisite in work of that description.

We have no doubt that the old-fashioned forge-hammer requires management. Indeed, it is difficult, in a district where forging is not generally carried on, to get men to work it. The steam-hammer men cannot (speaking of the generality) manage these massive servants: they take a job with great confidence, and work for perhaps two or three days, and then take their departure, out of sheer shame, to find the neat and natty steam-hammer that they have been accustomed to. We do not say the steam-hammer is inferior or superior, but we will say that the work produced by the old helve does successfully compete with anything produced by the steam-hammer: the rest of the question is commercial. Men require training to work these machines: an unskilful man places the use or bloom so that it will receive a blow where it is not wanted. Well, there is no help for it with the old hammer, unless the gagger can manage to avert it: with Nasmyth's arrangements, however, a false blow can be easily and instantaneously avoided. For plain work, such as heavy shafting of uniform diameter, the old hammer is fully equal to the new: for such forging as intermediate shafts, and work that requires much moving about on the anvil-block, Nasmyth's is perhaps the best. We understand that in the manufacture of the heavy plates for the Baltic gun-boats, the steam-hammers have been severely tried, and some found wanting. The old hammer at this sort of employment is eminently useful and efficient.

A system we should recommend is, that in order to keep the tools of an engine-factory in good repair, and to relieve them of the work of roughing the shafts, &c., let this be done at the forges, and the finishing effected by the engineers. To the advantage of giving rough work to rough tools, and fine work to fine tools, must be added the great saving in time and cost of carriage, supposing the shaft to be defective: this will generally be discovered in the roughing out. As we know the above is the practice of some eminent firms, we confidently assume it to be one of advantage to both forgemen and founder.

Before concluding our remarks, we must notice the extensive stables belonging to these works. In a detached building above the New Works, we found, in a lofty, well-ventilated stable, accommodation for 21 horses. Each horse has his address put up over his head, his name and number, many of the former having apparently been taken from the same elegant vocabulary used by the Government in choosing the names of their new gun-boats. The stalls are about 7ft. 6in. wide in the clear, and 9 ft. long: the average size of the stud is about 16½ hands. We understand this building was arranged by Mr. W. J. Horsfall, a member of the firm, and the visitor will most profitably devote half an hour to an inspection of it. In this case we may judge of the means by the end, and should imagine that Mr. Horsfall would willingly allow any one of his well-kept *units of horse power* to be taken as the standard by which to rate and pay for his steam horse power.

The carts, as may be supposed, need constant repairs, as their heavy and very often hot loads wear them fast. At present they are approximations to iron carts, inasmuch as they are lined and tied together with iron. In due time, we doubt not that we shall see them entirely constructed of this material.

Here we also must notice the large, handsome news-room provided for the men in the employ. Here are papers and periodicals to suit every variety of literary taste or public opinion; and it is a privilege that very few of their fellow-tradesmen enjoy.

We have now seen the Mersey Forge, and Liverpool has great reason to be proud of such an establishment. Though many are prejudiced against the description of hammer used here, look at the results—look at the work done by it, and we feel sure that, if fairly investigated and considered, the capabilities of Liverpool to produce wrought work of any shape, size, or quality will be estimated as highly as those of any other town in the kingdom. Nasmyth has had a very fair share of patronage bestowed upon him; but then he *has hammered* the Government into this. Here we must admit the advantage of the appearance and portability of his machine.

We recommend these works to the scientific amateur visiting Liverpool, to the mere sightseer, as well as to the engineering public, as an establishment in every way worth their consideration, and can assure them of a courteous and liberal reception by the enterprising principals of the Mersey Steel and Iron Company.

EXPLOSION OF STEAM-BOILERS.

Since penning our remarks on the case of the *Clyde* steamer, at another page, the following Circular has been issued:—

OFFICE OF COMMITTEE OF PRIVY COUNCIL FOR TRADE,
Marine Department, 1*st January*, 1855.

SIR,—I am directed by the Lords of the Committee of Privy Council for Trade to request that upon all future surveys, where it can be done without serious inconvenience, and at all events upon the next half-yearly surveys of the machinery of steam-vessels made with the view of giving declarations of sufficiency, you will be particular in observing the following rule, and that you will give immediate notice to the parties interested, so that there may be no delay or inconvenience when the time for making the surveys arrives:—

"No boiler or steam-chamber is to be so constructed, fitted, or arranged, as that the escape of the steam from it through the safety-valve, required by Act of Parliament, can be wholly or partially intercepted by the action of any other valve."

I am, Sir, your obedient servant,
To Engineer Surveyor. (Signed) T. H. FARRER.

PIRSSON'S CONDENSER (VACUUM).

This is a species of condenser in use in America for condensing the gross part of the steam by contact with cold surfaces and the attenuated vapour by jet. It does not change the mode of working the engine, nor increase its liability to derangement. If the condenser goes wrong, the engine can be worked at once without it, in the usual way of condensing wholly by jet.

"ALLEGHANY" STEAMER.

Fig. 1 is a longitudinal elevation of the condenser and evaporator, partly in section; Fig. 2, top view of same; Fig. 3, elevation of exhaust-end; A, case of cast-iron, strong enough to resist atmospheric pressure, perfectly air and water tight; *a*, nozzle to join the exhaust-pipe of the engine; *b* leads to and connects with the channel of the large air-pump;

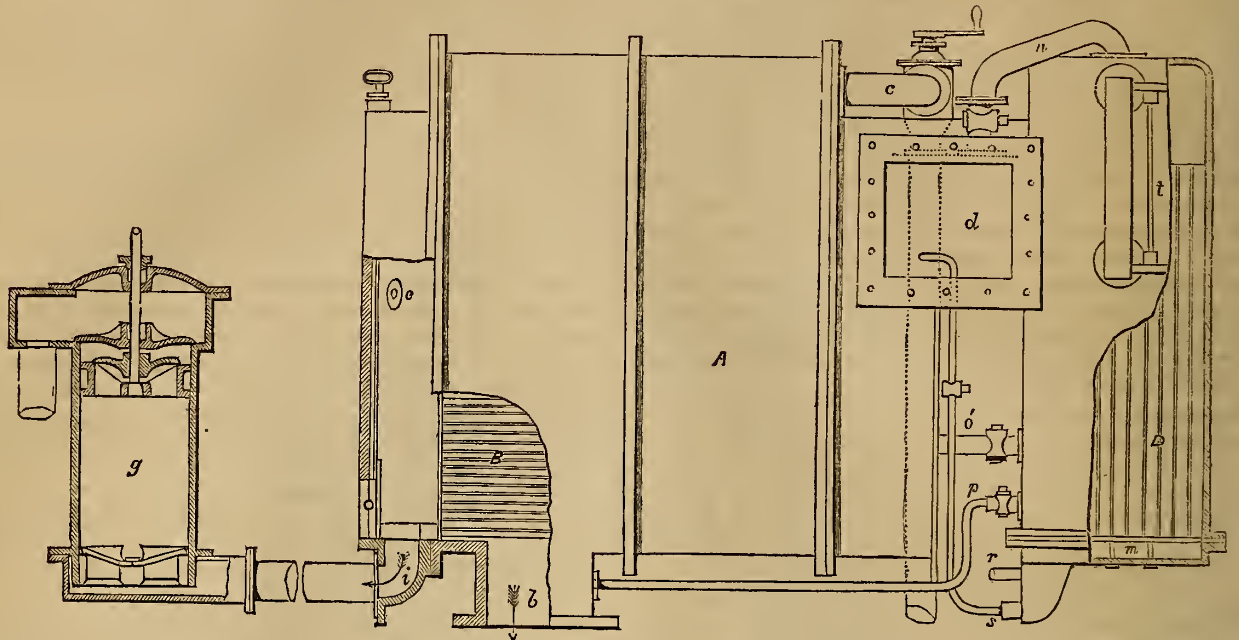


Fig. 1.

c, an injection-pipe; it extends along in the inside, and immediately over a perforated plate, *d*, for distributing the water upon the surface-condenser in the form of a shower.

B is the surface-condenser, consisting of a cluster of small tubes inserted in perforated plates, and covered by caps, *e*, *f*. In the cap *f* a hole is cut joining the exhaust-nozzle, *a*, through which the steam passes into the pipes. In the bottom of *e* is a discharge-hole leading to a channel which connects with a small air-pump, *g*; at *é* is a hole cut in the cap *e*; at *f′* is a screen, being a sheet of metal perforated with fine holes, to distribute the steam in equal quantities to all the tubes. The operation of this part of the apparatus is as follows:—

The engine is started, and the injection let on through *c*, as usual. The great air-pump communicating with the channel, *b*, and also the small air-pump, *g*,

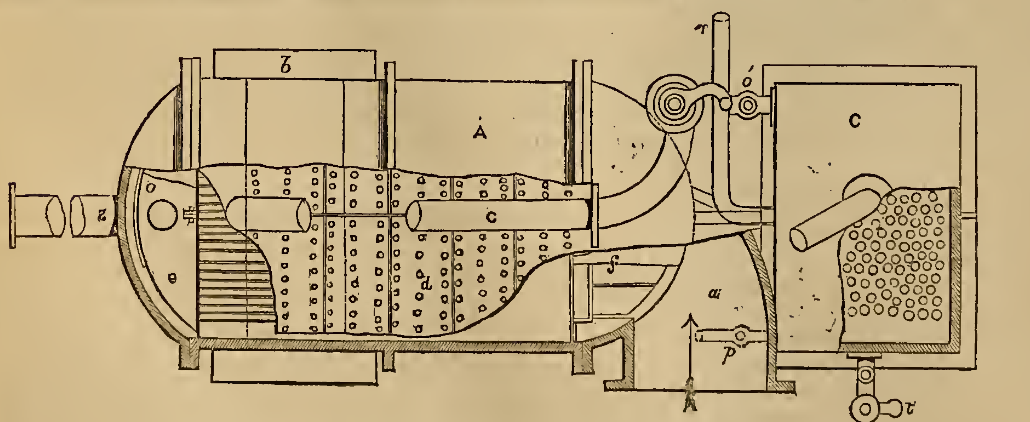


Fig. 2.

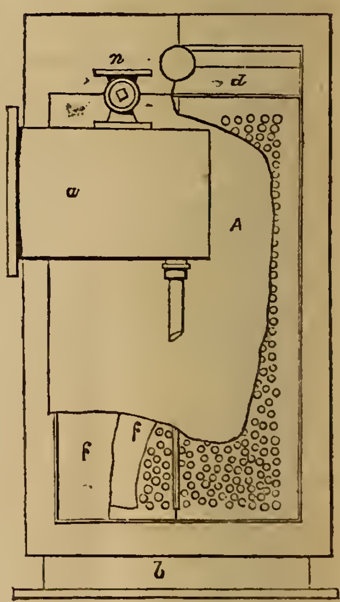


Fig. 3.

PIRSSON'S PATENT DOUBLE-VACUUM CONDENSER FOR U.S. STEAM-SHIP "ALLEGHANY,"—HALF-INCH SCALE.

now operate, the larger one removing the salt injection water, and producing a vacuum in A, while the small one, *g*, draws off the condensed steam through the channel *i*, and produces a vacuum *within* the surface-condenser. Now, it is evident that if there were only a *single* vacuum, so to term it,—that is, a vacuum within the surface-condenser, B,—then that would be required to sustain the pressure of the atmosphere; but, by reason of the large air-pump exhausting also the air from the case, A, the pressure is taken off the surface-condenser, and that, therefore, is not required to sustain any; but the case, A, sustains it as in a common condenser; hence a rupture only loses fresh water to a certain extent.

But, for further security, the aperture, *é*, is cut—an operation which would be *fatal* to any surface-condenser on the old principle. This insures at all times an equality between the vacuum in A and that in B; so that if any steam remain uncondensed through want of surface of cold water, it would flow through the aperture *é*, and be condensed by direct contact with the jet.

Thus, the engineer can work either way he pleases at a moment's notice, and without even stopping the engine, since, by withdrawing the valve, *o*, and unhooking the pump, *g*, from the working beam, he at once restores the engine to its common form.

To provide against expansion, the surface-condenser is quite detached from the case. The nozzle joining the exhaust, *á*, is merely a slip joint, and thus the whole mass of tubes may expand and contract together, without risk of rupture to any of the joints. In case of small leaks, the vacuum will not be impaired, because there is nothing present to enter.

There being no pressure, the surface-condenser may be of thin metal water spaces, or tubes may be used. The patentee prefers tubes.

Another apparatus is used to make up waste. This is an evaporator, seen at C. It is a case of metal, within which is a series of tubes, D, communicating at *m*, with a steam-chamber: *n* is a pipe connecting C with the exhaust-pipe, *a*; *ó* is a pipe to feed salt water to C; *p* is a pipe connecting C with the channel, *b*, leading to the large air-pump: *r* is a pipe leading to the boiler; *s*, a pipe discharging into the exhaust opening, *a*.

The operation is as follows:—As soon as a vacuum is formed in the condenser, there will be a like vacuum in the case, C, by reason of the connexion through *a*. Open now the cock in the pipe *ó*, and let salt water flow into the proper height as seen by the glass gauge, *t*. Steam is then let in through *r*, and entering the tubes, D, boils the sea-water; the vapour is drawn off into the condenser, and is there condensed along with the steam from the engine, going with it to the feed-pumps and thence to the boiler. This apparatus is, in fact, a still; and the water evaporated in C is added to the supply till the loss is made up. The pipe *p* is for removing a portion of the concentrated water, or is equivalent to a "blow-off" pipe in an ordinary boiler; *s* is a pipe to draw off the water from *m*, arising from the condensation of steam within the pipes, D: being fresh, it is thus saved. As soon as the boiler is filled up by this means, the salt water is all drawn off at *p*, and a stream allowed to flow through for a few minutes to wash all out. Then shut off everything, till the apparatus is wanted again.

In vessels with this condenser, notice should be given some little time before stopping the vessel, so as to obviate waste of fresh water from blowing off steam.

"ALLEGHANY'S" CONDENSERS.

Outside Shell, or Case.

	Inches.
Extreme length	$72\frac{3}{4}$
" height	$62\frac{1}{2}$
" width	$39\frac{1}{2}$

Surface Condenser.

Square feet in tubes	1,000 feet.
Length of tubes	4 feet.
Number of tubes	1,000
Diameter ot tubes (outside)	1 inch.
Weight of tubes	20 oz. to sq. ft.

This is calculated to maintain a vacuum of $26\frac{1}{2}$ inches, and to have the feed-water delivered at 130° F.

Evaporator.

	Inches.
Extreme height	71
" length	38
" width	$27\frac{1}{2}$

Copper Tubes.

Length	4 feet.
Diameter	$1\frac{1}{4}$ inches
Number of square feet	200

5

The following are the particulars of this species of condenser as applied in the *John L. Stephens*, Pacific steamer, 2,450 tons:—

	Feet.
Heating surface of boiler	6,109
Grate " "	168

The condensers are calculated to condense 18,000 cubic feet of steam at 202° F. per minute, at a vacuum of $27\frac{1}{2}$ inches, and delivering feed at 104° F.

On trial-trip, the pressure of steam varied from 2 to 20 lbs., averaging 12 to 15 lbs.; cut-off varied from one-third to one-half and two-thirds the stroke; vacuum, $26\frac{1}{2}$ inches, steady; feed-water, 129° F.; condensing surface to heating surface, as 1 to 3; quantity of condensing water required, the same as usual.

LLOYD'S RULES FOR THE CONSTRUCTION OF IRON SHIPS.

THE following rules for the construction of iron ships have just been issued by the Committee of Underwriters at Lloyd's. A Government regulation will also immediately come into force, providing that every iron vessel shall have two bulk-heads of the same scantling as the outside plating.

RULES FOR THE BUILDING OF SEA-GOING IRON SHIPS OF ALL DESCRIPTIONS, WHETHER SAILING VESSELS OR NAVIGATED BY STEAM.

Considering that iron shipbuilding is yet in its infancy, and that there are no well-understood general rules for building iron ships, the Committee have not deemed it desirable to frame a scheme compelling the adoption of a particular form or mode of construction, but that certain general requirements should be put forward, having for their basis thickness of plates and substance of frame, showing a *minimum in each particular* to entitle ships to the character A for a period of years, subject, however, to certain periodical surveys, and also to a continuation of such character, should their state and condition justify it on subsequent examination. For the purpose of attaining this object, the following rules and the accompanying table of dimensions have been formed:—

1. *Quality of Iron and Workmanship.*—The whole of the iron to be of good malleable quality; the workmanship to be well executed, and to be submitted to the closest inspection *before* coating or painting, and any brittle or inferior article to be rejected. It is not intended to prevent the coating of the plates *inside* in the way of the frame.

2. *Keel, Stem, Stern, and Propeller Posts.*—The keel, stem, stern, and propeller posts, to be scarfed or welded together at discretion, and to be in size according to the table. If scarfed, the length of the scarfs to be regulated in the proportion of eight times the thickness of the keel; and the stern-posts and after end of keel, for screw-propelled vessels, to be double the thickness of and tapered fair into the adjoining length of keel.

N.B.—Where the keel and keelsons are made of several thicknesses of plates, the plates that form the keel to be in thickness, taken together, the same as is required for a solid keel as per table; and the butts of the several plates of which the keel is formed to be carefully shifted from each other, and from the butts of the garboard strakes.

3. *Ribs of Frames, Spacing, &c.*—The spacing and dimensions of the ribs or frames to be as per table; and the ribs or frames in as great lengths as possible, and to be fitted close on to the upper edge of the keel, and in all cases to extend to the gunwale; and wherever butted, to have not less than four feet lengths of corresponding angle-iron, fitted back to back, to cover and support the butts and receive the plating; and if welded together, the welds to be perfect, and the shifts not to be less than four feet.

4. *Reversed Angle-Iron.*—The reversed angle-irons to be in size as per table; and in vessels of 300 tons and upwards, to be rivetted on to *every*

other frame up to the height of deck-beam stringer; and in vessels above 1,000 tons, to be rivetted on EVERY FRAME to the height of the lower-deck or hold-beam stringer. The rivets for securing the angle-iron to the frame not to exceed six times their own diameter apart.

5. *Floor-Plates.*—The floor-plates to be in thickness as per table; the depth to be regulated according to the depth of the vessel, as described in foot-note of table; and the reversed angle-iron on the upper edges to run across each floor or frame to above the turn of bilge. A floor-plate to be fitted and rivetted to every frame; and at the ends of the vessel the floor-plates to be worked across the stem and stern posts, so as to support and unite the sides efficiently to each other.

6. *Middle-line Keelson.*—The middle-line keelson, if of single plate, to be of the same thickness as the floor-plates, and to be well fitted and rivetted to the same, and a reversed angle-iron to be fitted on each side, both of the top and the bottom, extending all fore and aft: the lower angle-irons to be secured to the reversed angle-irons on the top of floors. If box-keelsons be adopted, the plating to be of the thickness as per table, and in either case to be two-thirds of the depth of floor-plates.

7. *Bilge-Keelsons.*—The bilge-keelsons to be fitted and secured in an efficient manner, extending all fore and aft, and placed according to the form of the bottom.

8. *Plating.*—All plates to be well fitted and secured to the ribs and each other; the butts to be closely fitted, and to be united by having pieces or strips of not less than the same thickness as the plates, and of sufficient breadth for rivetting, as described hereafter. No butts of outside plating to be nearer each other than one space of frames, nor to be nearer to a scarf of keel than that distance.

The space between the outside plating and the frames to have solid filling pieces closely fitted in one length, of the same breadth as the frames.

9. *Clamps and Extra Stringers.*—All vessels to have a clamp or ceiling-plate fitted between each tier of beams, all fore and aft inside the frames; and in small vessels, where there is but one tier of beams, then about two feet below them. The plate to be of the same dimensions as given for stringer-plates upon beams in the table, and to be properly rivetted to the frame.

All vessels above 500 tons to have fitted between the bilge-keelsons and the hold-beams, at the upper part of the turn of bilge, strong angle-irons, as stringers, extending all fore and aft, rivetted back to back to the reversed irons on the frames; the size of them not to be less than those used for the middle-line keelson.

10. *Beams.*—The beams to be of dimensions as per table, and to be made of "bulb" or any other approved iron plates, with reversed angle-irons rivetted to the plates, and the upper-deck beams to be fastened to alternate frames; the lower-deck or hold beams to be fastened to every second and every fourth frame alternately, excepting in hatchways (where there must be half-beams), and to be well and efficiently connected or rivetted to the corresponding frames at the sides with brackets or knee-plates of thickness equal to the beams, and in length as per table. The beams of each deck to be over each other, and pillared.

11. *Rivets and Rivetting.*—The rivets to be of the best quality, and to be one quarter of an inch larger in diameter than the thickness of plates through which they pass in the stem, stern-post, and keel; and in the remainder of the plating, as per table, to be regularly and equally spaced, and carefully punched opposite each other, in the laps and lining pieces, or strips; to be countersunk all through the outer plating, and not to be nearer to the butts or edges of the plating, lining pieces to butts, or any angle-iron, than a space not less than their own diameter, and not to be further apart from centre to centre than three times their diameter, and to be spaced through the frames and outside plating a distance equal to eight times their diameter apart. When rivetted up, they are completely to fill the holes; and their points or outer ends are to be round or convex, and not to be below the surface of the plating through which they are rivetted. The stem, stern-post, keel, garboard strakes, and butts of outside plating, to be double-rivetted in all vessels. The butts and edges of outside plating to be truly fitted, carefully caulked, and made water-tight.

12. *Bulk-heads.*—All vessels to have, at least, two water-tight bulk-heads built at a reasonable distance from the ends, to extend from the keel to the upper deck in vessels of two decks, and to the middle deck in vessels of three decks; such bulk-heads to be well supported and strongly made of plates and angle-iron of sufficient thickness, according to their height and breadth. The angle-irons not to exceed 3 feet apart, and the whole to be efficiently connected and rivetted together, and to the corresponding floors, beams, and ribs.

13. *Ceiling.*—The wood ceiling or lining of vessels from 100 to 3,000 tons to be from $1\frac{1}{2}$ to 3 inches in thickness, in proportion to the tonnage; and to be so fastened to the reversed angle-irons or frames, that in the event of rivets springing or leaking, it may be easily removed.

14. *Decks, Water-ways and Plank-sheers.*—The decks, water-ways, and plank-sheers, if of wood, not to be less in thickness or inferior in quality than is prescribed for vessels built of wood of the same tonnage and grade. The flat of upper deck to be fastened by screw-bolts put through from the upper side, and to have nuts at under side of the angle-iron of the beams; and the water-ways to be similarly fastened to the stringer-plates.

15. *Vessels with Three Decks.*—In all vessels having three decks, the middle-deck stringers are to be fitted home to the outside plating, and rivetted to the angle-irons secured thereto; also to have an additional angle-iron extending all fore and aft inside of the ribs, and either above or below the stringers rivetted to the same, and to the reversed angle-irons on the frames. All vessels to have above each tier of beams a plate each side the hatchways, of not less than ten inches in breadth by half an inch in thickness, and extending all fore and aft throughout, and well rivetted to upper side of all the beams, deck-hook, and transom: also to have plates, where practicable, of the same dimensions, extending diagonally from side to side, rivetted to the upper side of upper-deck beams and stringer-plates.

16. *Rudder.*—The main-piece of rudder to be made of the best hammered iron, and so arranged as to ship and unship, where practicable, without docking; and the main-piece to be in size according to the table.

17. *Surveys.*—Vessels intended for either the 12, 9, or 6 years' grade, to be surveyed at least five times, in the following order, viz.:—

On the several parts of the frame, when in place, and before being coated, and before the plating is wrought.

On the plating during the progress of rivetting.

When the beams are in and fastened, but before the decks are laid.

Again, when the ship is complete, and before the plating is finally coated.

And, lastly, after the ship is launched, either in dry dock or laid on blocks, or otherwise, so that the keel may be examined.

All vessels to be subject to occasional or annual survey, when practicable, and every third year to be specially surveyed in dry dock, or laid in blocks, with both surfaces of outside plating exposed; also, at the expiration of the full period originally assigned, when the water-ways and plank-sheers, if of wood, are to be scraped bright; and at that time, if it is found that no material diminution of thickness, by corrosion or wear, has occurred, the vessel, being in all respects in efficient condition, may then be continued for a further period, not exceeding one-half the whole number of years first assigned.

On the expiration of the terms assigned to ships classed A, they will be liable to lapse (like ships built of wood) into the diphthong Æ class, unless again specially re-surveyed, to determine their claims to be allowed a higher character.

18. One year will be added to the character of all ships of the A class built under a roof which shall project at each end beyond the length, and on each side beyond the breadth, a quantity equal to one-half the breadth of the vessel.

19. Vessels not surveyed while building will be classed A from year to year only, but for a period not exceeding six years.

IRON SHIPS.

TABLE *of Minimum Dimensions of Frames, Plating, Rivets, Keels, Keelsons, Stems, Stern Posts, Floor Plates, Beams, Stringers, &c.*

Gross Tonnage.	Keel, Stem and Stern Post, for all grades.	Distance of Frames or Ribs from Moulding Edge to Moulding Edge, all fore and aft. Years. 12	Distance of Frames. Years. 9, 6	Frames or Ribs. Dimensions of Angle-iron for all grades.	Dimensions of reversed Angle-iron for all grades.	Thickness of Plates.† Garboard Strakes. Years. 12	Garboard Strakes. 9	Garboard Strakes. 6	From the Garboard to the upper part of Bilge and the Sheer Strakes; also thickness of ‡ Hold or Lower Deck Beams, and Middle Line Keelson. Years. 12	9	6	From Bilge to Sheer Strakes, thickness of ‡ Upper and Middle Deck Beams, § Floor and ‖ Stringer Plates upon Beam Ends; also Hooks and Crutches. Years. 12	9	6	Dimensions of Angle-iron on Beam Stringers or Keelsons, for all grades.	Rudder for all grades. Diameter at the Head.	Diameter at the Heel.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Ins.	Ins.
100	$5\frac{1}{2}\times1\frac{1}{2}$	16	18	$\frac{5}{16}\times2\frac{1}{2}\times2$	$\frac{4}{16}\times2\times2$	$\frac{7}{16}$	$\frac{6}{16}$	$\frac{5}{16}$	$\frac{6}{16}$	$\frac{5}{16}$	$\frac{4}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{4}{16}$	$\frac{5}{16}\times2\frac{1}{2}\times2$	$2\frac{1}{2}$	2
200	6×2	16	18	$\frac{5}{16}\times3\times2$	$\frac{4}{16}\times2\times2$	$\frac{8}{16}$	$\frac{7}{16}$	$\frac{6}{16}$	$\frac{7}{16}$	$\frac{6}{16}$	$\frac{5}{16}$	$\frac{6}{16}$	$\frac{5}{16}$	$\frac{4}{16}$	$\frac{5}{16}\times2\frac{1}{2}\times2\frac{1}{2}$	3	2
400	$6\frac{1}{2}\times2\frac{1}{2}$	16	18	$\frac{6}{16}\times3\frac{1}{2}\times2\frac{1}{2}$	$\frac{5}{16}\times2\frac{1}{2}\times2$	$\frac{9}{16}$	$\frac{8}{16}$	$\frac{7}{16}$	$\frac{8}{16}$	$\frac{7}{16}$	$\frac{6}{16}$	$\frac{7}{16}$	$\frac{6}{16}$	$\frac{5}{16}$	$\frac{6}{16}\times4\times3$	$3\frac{1}{2}$	$2\frac{1}{2}$
600	$7\times2\frac{3}{4}$	16	18	$\frac{7}{16}\times4\times3$	$\frac{6}{16}\times3\times2\frac{1}{2}$	$\frac{10}{16}$	$\frac{9}{16}$	$\frac{8}{16}$	$\frac{9}{16}$	$\frac{8}{16}$	$\frac{7}{16}$	$\frac{8}{16}$	$\frac{7}{16}$	$\frac{9}{16}$	$\frac{7}{16}\times4\frac{1}{2}\times3\frac{1}{2}$	$4\frac{1}{4}$	$2\frac{3}{4}$
800	$7\frac{1}{2}\times3$	16	18	$\frac{8}{16}\times4\frac{1}{2}\times3$	$\frac{6}{16}\times3\times3$	$\frac{11}{16}$	$\frac{10}{16}$	$\frac{9}{16}$	$\frac{10}{16}$	$\frac{9}{16}$	$\frac{8}{16}$	$\frac{9}{16}$	$\frac{8}{16}$	$\frac{7}{16}$	$\frac{8}{16}\times5\times4$	$4\frac{1}{2}$	3
1000	$8\frac{1}{2}\times3$	16	18	$\frac{8}{16}\times5\times3$	$\frac{7}{16}\times3\frac{1}{2}\times3$	$\frac{13}{16}$	$\frac{11}{16}$	$\frac{10}{16}$	$\frac{11}{16}$	$\frac{10}{16}$	$\frac{9}{16}$	$\frac{10}{16}$	$\frac{9}{16}$	$\frac{8}{16}$	$\frac{9}{16}\times5\times4\frac{1}{2}$	5.	3
1200	9×3	16	18	$\frac{9}{16}\times5\times3\frac{1}{2}$	$\frac{8}{16}\times3\frac{1}{2}\times3$	$\frac{14}{16}$	$\frac{12}{16}$	$\frac{11}{16}$	$\frac{12}{16}$	$\frac{11}{16}$	$\frac{10}{16}$	$\frac{10}{16}$	$\frac{9}{16}$	$\frac{8}{16}$	$\frac{9}{16}\times5\frac{1}{2}\times4\frac{1}{2}$	5	$3\frac{1}{4}$
1500	10×3	16	18	$\frac{9}{16}\times5\frac{1}{2}\times3\frac{1}{2}$	$\frac{9}{16}\times4\times3\frac{1}{2}$	$\frac{15}{16}$	$\frac{13}{16}$	$\frac{12}{16}$	$\frac{13}{16}$	$\frac{12}{16}$	$\frac{11}{16}$	$\frac{11}{16}$	$\frac{10}{16}$	$\frac{9}{16}$	$\frac{9}{16}\times6\times5$	$5\frac{1}{2}$	$3\frac{1}{2}$
2000	12×3	16	18	$\frac{10}{16}\times6\times4$	$\frac{10}{16}\times4\frac{1}{2}\times3\frac{1}{2}$	$\frac{16}{16}$	$\frac{14}{16}$	$\frac{13}{16}$	$\frac{14}{16}$	$\frac{13}{16}$	$\frac{12}{16}$	$\frac{12}{16}$	$\frac{11}{16}$	$\frac{10}{16}$	$\frac{10}{16}\times6\frac{1}{2}\times5\frac{1}{2}$	6	$3\frac{3}{4}$
2500	$12\times3\frac{1}{4}$	16	18	$\frac{11}{16}\times6\frac{1}{4}\times4$	$\frac{10}{16}\times4\frac{1}{2}\times3\frac{1}{2}$	$\frac{16}{16}$	$\frac{15}{16}$	$\frac{14}{16}$	$\frac{15}{16}$	$\frac{14}{16}$	$\frac{13}{16}$	$\frac{13}{16}$	$\frac{12}{16}$	$\frac{11}{16}$	$\frac{10}{16}\times6\frac{1}{2}\times5\frac{1}{2}$	$6\frac{1}{2}$	4
3000	$12\times3\frac{1}{2}$	16	11	$\frac{11}{16}\times6\frac{1}{2}\times4$	$\frac{10}{16}\times4\frac{1}{2}\times3\frac{1}{2}$	$\frac{16}{16}$	$\frac{15}{16}$	$\frac{14}{16}$	$\frac{15}{16}$	$\frac{14}{16}$	$\frac{13}{16}$	$\frac{13}{16}$	$\frac{12}{16}$	$\frac{11}{16}$	$\frac{10}{16}\times6\frac{1}{2}\times5\frac{1}{2}$	$6\frac{3}{4}$	$4\frac{1}{2}$

Proportionate Diameter of Rivets	$\frac{5}{8}$ of an inch.			$\frac{3}{4}$ of an inch.			$\frac{7}{8}$ of an inch.				1 inch.		
To Thickness of Plates.........................	$\frac{4}{16}$	$\frac{5}{16}$	$\frac{6}{16}$	$\frac{7}{16}$	$\frac{8}{16}$	$\frac{9}{16}$	$\frac{10}{16}$	$\frac{11}{16}$	$\frac{12}{16}$	$\frac{13}{16}$	$\frac{14}{16}$	$\frac{15}{16}$	$\frac{16}{16}$

* When hollow plate keels are adopted, their thickness should not be less than one and a half that of the garboard strake.
† Plating not to be reduced in thickness at the ends of the vessel from keel to upper edge of wales.
‡ All beam-plates to be in depth one quarter of an inch for every foot in length of the midship beam; to have double angle-iron upon upper edge, siding and moulding together of each to be not less than three-fourths the depth of beam-plate.
§ Depth of floor-plates not to be less than one inch for every foot of the vessel's depth in hold.
‖ Stringer-plates upon beams to be in width twice the siding and moulding of the angle-iron frames; each arm of knee-plates to be in length three times the depth of beams.

The rivets to be of the best quality, and to be one quarter of an inch larger in diameter than the thickness of the plates through which they pass in the stem, stern-post and keel, and in the rest of the plating as per table; to be regularly and equally spaced, and carefully punched opposite each other in the laps and lining pieces or strips; to be countersunk all through the outer plating, and not to be nearer to the butts or edges of the plating, lining pieces to butts, or any angle-iron, than a space not less than their own diameter, and not to be further apart from centre to centre than three times their diameter, and to be spaced through the frames and outside plating a distance equal to eight times their diameter apart. When rivetted up, they are completely to fill the holes, and their points or outer ends are to be round or convex, and not to be below the surface of the plating through which they are rivetted. The stem, stern-post, keel, garboard strakes, and butts of outside plating to be double-rivetted in all vessels.

By order of the Committee.

, *Chairman.*

London, 14th December, 1854. CHARLES GRAHAM, *Secretary.*

THE LATE BOILER-EXPLOSION OF THE "CLYDE" SCREW STEAM-SHIP.

THE annexed sketch of the Safety and Stop Valve Box of the *Clyde* will, we trust, be interesting to our readers.

The valve-box stands partly on the forward and partly on the after boiler. The double-beat valves A A, with their spindles, passing through close bonnets and loaded externally, are the safety-valves. These valves are common to both boilers.

The valves B and C, intended to be self-acting, are made to open or shut the communication with their respective boilers.

The branch D forms the connexion with the main steam-pipe, leading to the cylinders.

The pipe E is the waste-steam pipe.

The facts of this case are as follows:—The *Clyde*, on her passage from Greenock to Portsmouth (in December last), where she was proceeding to take in stores for the seat of war in the East, was within about a dozen miles from the latter port, when one of her boilers burst, by which two stokers were killed, her Chief Engineer and two of the crew seriously scalded.

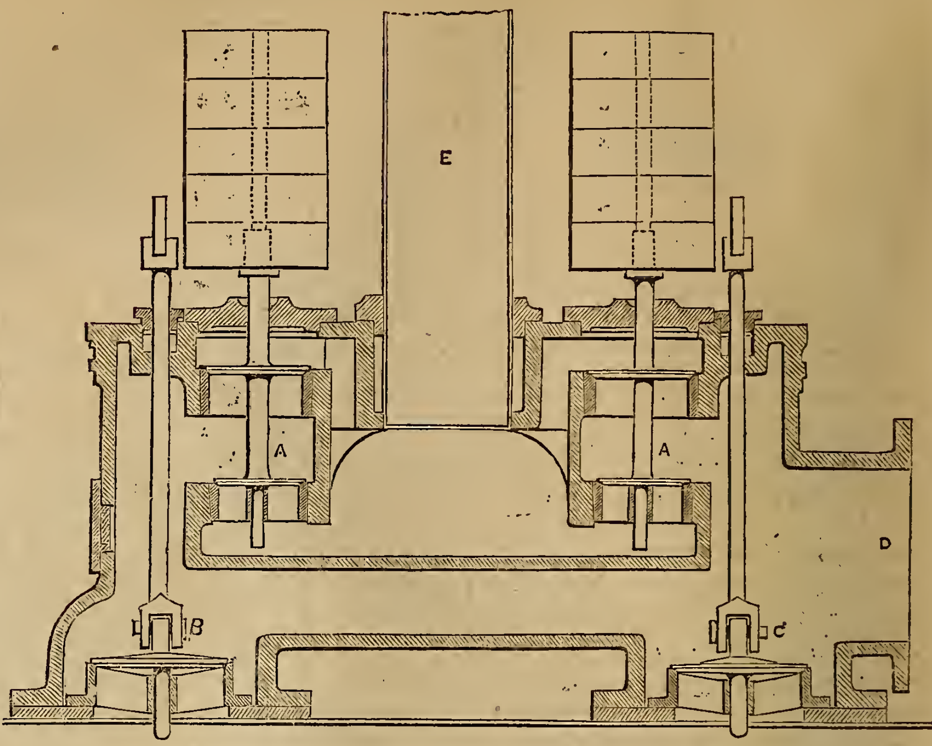
The part which gave way was the uptake near the bottom of the chimney, which is of this form. The dotted lines show how the plates were forced up by the explosion.

From the evidence, it appeared that the cause of the accident was, that the valve B on the forward boiler, which should have been self-acting, was found shut. This arose either from a bent spindle, or the parts having *set fast.*

The Coroner's Jury, after two long sittings, came to a rather reluctant verdict of Manslaughter against the Chief Engineer. It appeared that this reluctance on the part of the Jury arose from the impression which the evidence made on their minds that there were extenuating circumstances in favour of the Engineer, in connexion with the construction and position of the valve-box. It was stated in evidence by Mr. Murray, of the Dockyard, that it was with the greatest difficulty he could get to the valve-box at all; that, to get to it, he had to squeeze himself through a man-hole in the deck or funnel casing. As, however, the case will come before the proper tribunal in due course, we have no wish to prejudge it, and adjudge who, in our opinion, are the responsible parties. But, as engineers, we would say to our friends on the Clyde, that after this fatal accident, they will never again, we trust, attempt to make such an arrangement.

The valve-box is certainly snug; but it is as certainly complex, expensive, and we should have always said that it is *unnecessarily dangerous.* Neither can we see what can be gained by such an arrangement; for suppose that it is required to open up the slide-valve, or that any bad joint or accident should occur in the steam-pipe, no careful engineer would attempt to shut these stop-valves till he had drawn his fires, or completely extinguished the evaporating power of his boilers.

To the Board of Trade Surveying Officers it is to be hoped that this accident will not be lost, and that, however such arrangements may be sanctioned by *precedent* and names of good engineering firms, the public will look to them as jointly responsible that no accident shall again occur from a similar cause.



Stop and Safety Valve Box of "Clyde." Scale one inch = one foot.

AMERICAN NOTES.—No. II.

The Nautilus Submarine Company.—This is the title of an association here, organised for the purpose of submarine explorations and operations, by means of a novel apparatus, of which we subjoin a sketch and description:—

The form of the machine is not arbitrary, varying for different purposes, although still embodying the same principles. For general purposes, a machine formed by the junction of the frustra of two cones at their largest bases—the top and bottom of the surface thus formed being segments of spheres—is most convenient. Entrance is effected through the top at Y (see cut). In the angle formed by the junction of the sides are a series of tanks connected together at top and bottom by pipes, *a a*. The inner surface of these tanks being vertical, the working chamber is consequently a cylinder, the spaces between the tanks serving as receptacles for windlasses, tools, and implements necessary for use below. These tanks, shown at *d d*, have communication with the outside by a valve shown at *f*, which may be opened and closed at will. At B a pipe is represented which communicates with the hose leading to condenser. Two valves—one, C, permits the passage of air directly to interior of diving-chamber; the other, D, throws the pressure directly to the interior of the tanks. At E is seen another pipe with single valve; one extremity of this pipe opens into the tanks, the other through the top of the machine. An opening at the bottom is represented at F. The operator having entered and the man-hole Y being closed, opens the water-valves *f f*, and at the same time opens the valve on the pipe E. The tanks being filled with air, as the water enters through the lower or water valves, the air rushes out before it (and the machine being previously ballasted, so that the tanks filled with water, its buoyancy will be destroyed), descent commences until the machine is submerged, when the air and water valves are closed, and the movement continues until the bottom is reached. This descent may be slow or rapid. Air to resist the pressure of the water upon the surface of the machine may be let in previous to, or during the descent; suitable gauges being provided to indicate the pressure of air and water. These gauges marking the same point, an equilibrium of forces is attained, and the cover of the hatchway F, or opening in the bottom, may be swung off and communication held with the bottom.

The machine having its buoyancy barely destroyed, weighs a very small amount at the bottom. It is moved about by three cables affixed to anchors previous to descent. The cables running from windlasses, M, inside, through stuffing-boxes, N, in the bottom, thence over moveable pulleys, O, on the outside, pass off in directions forming equal angles with each other. By working these cables unequally, any point included within the circle described by them as radii may be reached. In current way, one alone may be used. The anchor being placed up stream, by moving a rudder, oscillation will be effected, and by changing length of cable any point may be gained in this way. This method is peculiarly adapted for examining beds of rivers, as it is evident the whole bed from bank to bank can be examined. Even in eddy currents this machine cannot be moved from any desired spot, as the position of the cables forbids it. These anchors may be picked up by the machine, or subsequently raised to the surface.

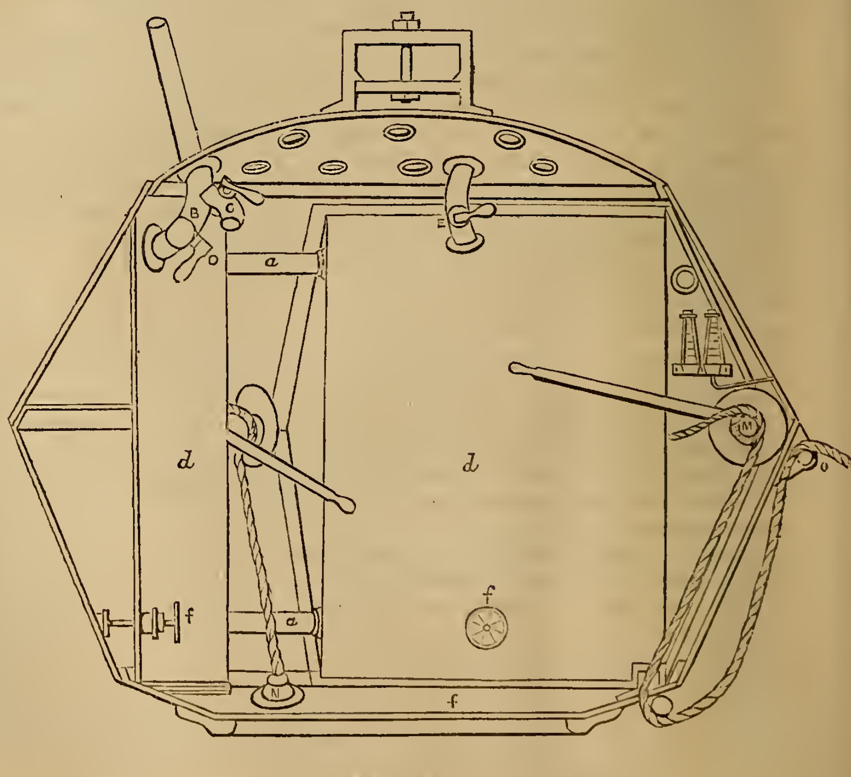


Fig. 1.—Elevation through Centre.

The divers have free communication with the bottom and any objects situated there, such as corals, sponges, and pearl shells, marine plants, or sands, or earth. The operations are carried on through the bottom, and as often as sacks or other vessels are filled with these products, they may be sent at once to the surface, by raising the machine slightly, and applying the power of condensed air to cause their ascent. For building foundations of piers, it is merely necessary to discharge the stones into the water in the vicinity of the required spot. The machine is then affixed to them. The tanks (holding sufficient water, according to the size of the stones in use) are then emptied; by merely opening the water-valves and turning the supply of air in, the water rushes out, the machine becomes buoyant, the stone is raised sufficient to clear it—then the machine is moved over the designated spot, water is again let into the tanks, buoyancy is destroyed, and the stone deposited. But not occupying the precise spot, successive vertical and horizontal movements may be made by working the air and water valves, alternately assuming and destroying buoyancy, till any precise position is gained. Here we have no crane-work, no power above to communicate with, no application of animal labour. Condensed air does all. Two men only are needed to make fast and operate the suspended mass, which may be one ton or ten. According to size of tanks is the power of machine. To raise a sunken vessel, it is obvious that the weight distributed throughout at various points of support will be more safe than at two or three points only. Without leaving the machine, bolts all prepared to receive "camels" can be placed directly into the timbers of a ship. "Camels" being placed thereto, on being inflated, will gently raise the vessel to the surface. To explore a wreck within, armour, always in readiness, may be put on, the hose affixed to the air-tube within; the machine slightly raised, the diver walks out, graduating his own supply of air; when the labour is accomplished, he signals—the machine is raised, he enters, doffs his armour, and is ready to proceed with his work. The day's labour accomplished, the machine is closed, air turned into the tanks, water expelled, and immediate ascent to the surface is attained. The pressure within is reduced by blowing off. The operators open, leave, and then close the machine—leaving it to float, restrained by a single hawser.

Great depths may be attained, since the operator is enabled to graduate his receipt of air according to his feelings, taking on small quantities until the whole amount necessary is received, which amount, for deep water, could never have been taken all at once, as is required by other bells and armour. This is evident, since the pores of the skin, charged with ordinary atmosphere, *must expand*, and exchange their contents for a more condensed fluid. If this change is gradual, but little pain is experienced; but sudden reaction is oftentimes fatal, and beyond the power of man to encounter when long continued. After this change of the system has been produced, man will breathe and move as freely as before, for the same state of equilibrium as before will prevail in his system. An increased state of vitality will result, owing to the greater amount of oxygen contained in the same volume of air at each inhalation. This will increase his strength for the time being. Relieving the pressure in the same gradual way, no difficulties present themselves. A constant supply of pure air is continuously supplied to the divers. A reduction of temperature below the water causes the air, which by inhalation has become charged with carbonic acid, to descend to the bottom of the machine; a small stream of air entering at the top destroys the equilibrium between the air and water, and the bottom being open, the lower strata of air, or foul air, is constantly passing out. The bottom closed, a self-acting valve opening outwards carries this discharge on continuously.

By an arrangement of a moveable coffer-work in the bottom, trenches may be dug four or six feet through the earth, forming a receptacle for telegraph wires, water-pipes, &c., to place them below the reach of anchors. No matter how yielding the mud or earth, it offers no objection, as the surrounding earth is kept back until the trench is dug, when it fills itself up at once.

The pump used in connexion with this machinery is of an entirely new and novel construction. According to its size, it may throw from four to forty thousand cubic feet of air per hour. This amount of air would inflate camels to raise a two thousand ton ship in one hour. Being under control, any accident happening to hose or any of the camels, it can at once be stopped, until the difficulty is remedied.

Again, the advantage of air over any gases is that by the sudden evolution of gases, *immediate* inflation must take place. A pipe twisted, a connexion fouled, throws the accumulated pressure of the gas upon certain points which must give way.

This matter was examined some years since by the scientific men of England and France, and pronounced *not practical*, as too many risks are attendant upon the use of gas of any kind. The advantage of air is, that having a sufficient supply, there are no risks at all in its use; no explosions, no danger—everything is carried on gradually and safely.

The value of the pearl, coral, and sponge fisheries is too well known to require further mention. The difficulty heretofore has been the want of machinery to work in sea-way, to remain down a long time, to move about freely, and possess the power of transmitting gathered objects to the surface.

The vast amounts of treasure which from time to time have been sunk in various parts of the world, the position of which is well known, should be recovered for man's uses.

In conclusion, one word regarding building of foundations. Stone may be laid in any depth of water that is required, at an expense of less than one-quarter of that now required by any known process. Piers, bridges, &c., of a *permanent* character will be constructed, since the means exist. England alone expends hundreds of thousands annually on her piers and breakwaters, all of which are now laid by the old diving-bell. English and French Government engineers have fully indorsed the process presented here.

I have this day visited an exhibition of the operation of this instrument. The location selected was that of the Atlantic Dock, Brooklyn; the instrument, one of three belonging to the Nautilus Pearl Fishing Company; and the experiments were witnessed by a party of invited guests, from on board the barque *Emily Banning*, belonging to and fitted out by the last-mentioned company at a cost of £10,000 sterling, and about to sail for the Spanish Main, on a submarine expedition, in all this week.

The operation of this instrument in every respect was positively satisfactory, being of a character to receive the approbation of engineers who examined its construction, and witnessed the facility with which it was depressed, held in position, elevated, or moved aside.

The designer of it, and executive officer of the company, was formerly in the service of the United States, having graduated at the West Point Military Academy.

American Steamboats in China. — Our countrymen are about making another demonstration in Chinese waters. The steamboat *River Bird*, now fitting with engine and boiler, at the works of Penn and Murphy, is nearly completed, and will be ready for sea in the latter part of this month (January). The following particulars will give a fair idea of her build, and of her suitability for river purposes:—

Length on deck	180 feet.
Breadth of beam	29 "
Depth of hold	10 "
Tonnage	470 tons.

Engine, vertical beam; cylinder, 41 inches diameter, with a stroke of piston of 10 feet; water-wheels, 26 feet in diameter; drainage of water at lead-line, 6 feet.

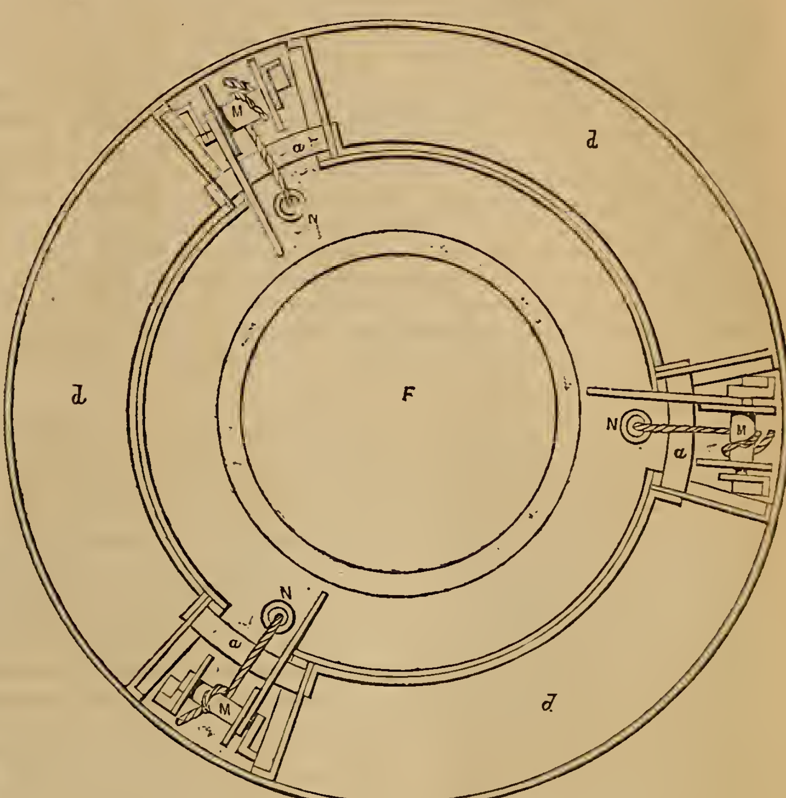


FIG. II.—PLAN AND HORIZONTAL SECTION THROUGH CENTRE.

This vessel is like to the river-steamers of this country, with the difference of having greater strength of hull, her boiler being below deck, and her water-wheel guards projecting but three feet over the sides of the boat, instead of keeping the full width at the wheel-house until they taper off at the ends. She is rigged as a three-masted brigantine, is coppered, copper-fastened, and trussed with diagonal and double-laid iron braces.

New York and Liverpool Line.—It is asserted here, and it is fully credited, that a well-known capitalist and successful proprietor of steamer-routes is about to build six steamers for this route.

The "Ocean Bird."—This is the name of the steamer better known as the *Six-day Boat*, a *sobriquet* she received from the circumstance of her having been originally designed for the route from here to Galway, and her builders alleging that she would make the run in six days.

The company for which she was built having failed to go into operation, she was sold in an unfinished state at public auction, and bought by Captain John Graham, who is now fitting her for service or sale. He has contracted with Messrs. Guion, Boardman, and Co., proprietors of the Neptune Iron Works, for an engine and boilers, and has confided the superintendence of their construction and erection to Mr. Charles H. Haswell, formerly Engineer-in-Chief of the Navy, and now located in this city as a consulting and superintending engineer. The engine is to be of the vertical over-head beam description, with a cylinder 65 inches in diameter by 12 feet stroke of piston, with four return-flued boilers.

New York. H.

RAMBLES AMONG THE REAPERS.

By R. S. Burn.

(Continued from page 9.)

The reaping-machine invented, in 1815, by Mr. Scott of Ormiston, factor or steward to the Earl of Hopetoun, next demands our attention. There is a close resemblance between this and Mr. Smith of Deanston's machine. The gatherer in both is a conical drum; but in Mr. Scott's the cutting was performed by a series of small-toothed sickles, sixteen in number, placed in a revolving wheel. The gathering of the corn was aided by a series of jointed prongs or fingers, which projected in front of the revolving cutters. These "collectors," or prongs, by peculiar mechanism, were made to be thrown out, so as to catch the corn and bring it up to the cutters. After the corn was cut, the collectors were thrown in, so as to release the corn, and allow it to be laid in a continuous swathe. The standing corn was divided from that which was to be cut by a sheet of thin plate-iron, kneed to the same angle with the projecting prong, and of the same height as the gathering conical drum. Another sheet of iron was placed in an inclined position on the left-hand side of the machine, so as to prevent the progressive motion from carrying the root end of the cut corn too far forward. A series of thin brushes were fixed to the under side of the conical drum: these were intended to sweep forward the root end of the cut corn, and to keep the cover-plate clean swept.

In connexion with the trials of this machine, a variety of experiments were made to ascertain the best form of cutter. The result of these went to prove that the draw-cut of the common reaping-hook was inferior to none. It cuts well, and requires very seldom sharpening; a common reaping-hook often working for a whole season without requiring any sharpening. The front prongs, against which the cutters cut the corn, were not made straight in this as in other machines, but were inclined to the cutter in lines at an angle of forty-five degrees. This arrangement was adopted in order to give all the cutters an equal advantage, whatever their position in the revolving circle to which they were attached. The sickles, or cutters, were attached to the revolving wheel at an angle of forty-five degrees to its diameter; this being the angle necessary to enable the sickles to give cuts similar to the draw-cuts of a common reaper.

In this machine, the horse pulled in a manner similar to that in which canal-boats are tracked—long handles being furnished to the machine, by which a man could keep it at right angles to the line of the corn, in this way producing an effect similar to the helm by which the canal-boat is steered. The first trial of the machine was made in a "small corner of coarse, new broken-up lea ground, sown for the first time with oats, of about thirty yards in length;" and, so far as it went, was satisfactory enough, although the strength of the machine was ill calculated for the work which it had to perform. Although, in this trial, the corn was "cut and collected in a very neat manner the length of the plot," not a single uncollected straw being left behind, and the swathe being formed in a regular way; nevertheless, the machine, from some cause or other, never proceeded beyond the status of a preliminary trial or trials, but was laid aside, to swell the list of unsuccessful—unsuccessful in a commercial, if not in a mechanical point of view—reaping-machines.

We now come to notice a reaping-machine which was invented, in 1820, by Mr. Joseph Mann, of Raby, Cumberland. It was not, however, till 1832 that it was brought into efficient operation. The late Mr. Slight, of Edinburgh — a first-rate authority — considered this machine as possessing the germs at least of the *four points* which its inventor held to be the ultimatum sought for in a reaping-machine. These four points are worthy of being noted here:—1st. It preserved the parallelism of the line of draught, though that draught was applied to one of its angles in front; 2nd. A polygonal cutter; 3rd. The gathering process from the cutter, performed by a series of revolving rakes; 4th. The process of stripping the rakes in such a manner as to lay down the cut corn in a regular swathe by the side of the machine as it progressed.

The plan of the framework of the machine was that of a trapezium; the fourth side having the acute angle at the left, or nigh side: to this the draught was applied by means of a pair of horse-shafts. The framework was supported by three wheels; two of a diameter of 3 feet, one on each side toward the rear: one was on the off-side, about a foot in advance of the other; from this the working motion was derived. The hind, or grinding wheel, was only 2 feet diameter, and was attached to a sloping swivel-shaft, in connexion with the angle to which the shafts were attached. A fourth and smaller wheel was placed directly under the shaft of the cutter. The cutter was on the revolving principle; but, in place of being circular, it was polygonal, having twelve equal sides. By having this form, the corn is not cut by a continuous stroke, but rather by a series or succession of quick strokes, "arising from the inclination of the cutting edges in the sides of the polygon to each other: for, as will readily be understood, from the angles of the polygon being further from the centre of revolution than any point in the straight side thereof, any opposing body, as a stalk of corn, will be forcibly acted upon when the angle is passing the stalk; and, if passing without completing the separation, the progressive motion of the whole machine will not only keep the edge in contact through the first half of the passing side of the polygonal edge, but, as the next angle approaches the stalk, it will receive the more impressive stroke from the remaining half side to complete the severance; and so of all the rest."

The cutters were formed of thin steel plates, and were attached to the extremities of twelve horizontal arms, these being attached to a vertical revolving shaft. The diameter of the cutter, thus arranged, was 4½ feet, and revolved at the rate of 175 revolutions per minute. The segments forming the cutter were attached to the arms by "a slender slide-bar of iron, rivetted on to each side of the segments; and these slides, two together, being those of the two contiguous ends of two segments, were passed through a clasp in the ends of the arms, and thus secured by a pinching screw." By this method, the segments could be easily removed, and a new sharpened set placed in a few minutes.

The corn, as it fell from the cutter, was gathered by revolving rakes: these were attached to a skeleton cylinder, revolving upon the vertical shaft of the cutter. The cylinder, with its attached rakes, revolved concentric with the cutter in the same direction, but at a greatly reduced rate, the proportion being as one to seven. As the cylinder revolved, the rakes caught the corn as it was cut, and carried it to the near side. To free the rakes from the collected corn, an apparatus, termed a comb, was used. This was attached vertically to the side of the machine, and the teeth projecting from it passed between those of the rakes, and stripped the corn as they came in contact. The corn was thus laid in a continuous swathe at the side of the machine, nearly at right angles to the line of direction. To prevent any of the corn getting within the teeth of the comb, a line of thin wire was twisted round each horizontal row of teeth, forming a number of bands standing about two inches from the roots of the teeth. As the parts of the teeth of the comb were always within the circles formed by the wires, they caught every straw which was taken hold of by the rakes. "The gearing of the machine was extremely simple. On the axle of the off-side carriage-wheel, already alluded to, was fixed a bevel wheel of 56 teeth, which acted on a horizontal wheel of 28 teeth; and upon the vertical shaft of this last were mounted two pitch or chain wheels—the one of 8 teeth, the other of 28: these, by means of two pitch-chains, acted upon two other wheels, of 21 and 9 teeth respectively, placed upon the rake-cylinder and upon the cutter-shaft. * * * Besides these active motions, there was provision, by means of levers, &c., by which the height of the stubble could be regulated almost instantaneously, and the revolving parts thrown out of gear; and also for raising or depressing either side of the machine, to omit the rounding of ridges and deep furrows. The power required to draw this reaper was one horse, and with this it cut down a breadth of three feet: so, taking its rate of travel at 2½ miles per hour, its performance, by calculation, is limited to 9 acres in 10 hours, or thereby; but, in actual work, it might not exceed 7 acres in that time."

In the recorded trial of this machine at the show of the Highland and Agricultural Society, at Kelso, in 1832, the work performed was very satisfactory, even under most unfavourable circumstances. "The portion (says Mr. Slight, from whose report we have drawn up our description) of the field acted upon had been later than the other parts; hence it was left uncut, and was still unripened—and, withal, thought so worthless, that cattle had been allowed to traverse it. But, notwithstanding all this, the machine performed the operation of cutting much better than could have been expected under the circumstances, while the laying of the cut corn was performed very regularly." *

The next machine to be described in chronological arrangement is that of Mr. Ogle, schoolmaster, Renington, near Alnwick, Northumberland. This machine was brought out in conjunction with Thomas Brown, founder, of that place. Its claims to notice were very pretentious; every act of reaping being performed by it, with the exception of binding and placing the sheaves. There is a remarkable coincidence of arrangement between this and the celebrated machine of M'Cormack.

(To be continued.)

REVIEW.

Practical Illustrations of School Architecture. By Henry Barnard, Superintendent of Common Schools in Connecticut. Second Edition. New York: C. B. Norton. London: Trübner and Co.

(FIRST NOTICE.)

We are glad to see this work introduced to the notice of the British public. It meets a want long demanded. Viewed from any point, the subject of which it treats is one of vast social importance. If the education of the young is a matter of primary importance to us as a community, every aid and appliance by which the important end can be carried out must bulk largely in the estimation of reflecting minds. It is difficult, indeed, to estimate the evils arising from defective school architecture, taking the term in its widest acceptation, as involving considerations connected with the site, external appearance, internal arrangements, and the various appliances for the furtherance of architectural pursuits.

That the question of school architecture has not been taken up in this country in the way which its importance deserves, is patent to every one who chooses to give a moment's consideration to the subject. Its importance, indeed, has not been at all recognised; and if so, only in a few exceptional cases, and within a very recent period. As keeping our subject before the public mind, and as likely to influence those who have it in their power to introduce a different state of matters from those which have so long and so prejudicially operated, we clearly perceive the immense advantages which might accrue from the permanent establishment of an educational museum. For this, in passing, we may remark, the educational world are indebted to the Society of Arts—a body never wanting in the promulgation of practical measures and schemes. The moral, intellectual, and sanitary importance of the question cannot be better indicated than in the following remarks of the author. The condition of the American District School-houses, as there described, answers equally well for too many of our country and urban schools. "The subject was forced on the attention of the author in the very outset of his labours in the field of public education. Go where he would, in city or country, he encountered the district school-house standing in disgraceful contrast with every other obstacle designed for public or domestic use. Its location, construction, furniture, and arrangements seemed intended to hinder and not promote, to defeat and not to perfect, the work which was to be carried on within and without its walls. The attention of parents and school-officers was early and earnestly called to the close connexion that existed between a good school-house and a good school, and to the great principle that to make an edifice good for school purposes, it should be built for children at school and their teachers; for children differing in age, sex, size, and studies, and therefore requiring different accommodation; for children engaged sometimes in study and sometimes in recitation; for children whose health and success in study require that they shall be frequently and every day in the open air for exercise and recreation, and at all times supplied with pure air to breathe; for children who are to occupy it in the hot days of summer and the cold days of winter, and to occupy it for periods of time in different parts of the day, in positions which become wearisome if the seats are not in all respects comfortable, and which may affect symmetry of form and length of life if the construction and relative heights of the seats and desks which they occupy are not properly attended to; for children whose manners and morals—whose habits of order, cleanliness, and punctuality—whose temper, love of study, and of the school, are in no inconsiderable degree affected by the attractive or repulsive location and appearance, the inexpensive out-door arrangements, and the internal construction of the place where they spend or should spend a large part of the most impressible part of their lives. This place, too, it should be borne in mind, is to be occupied by a teacher whose own health and daily happiness are affected by most of the various circumstances above alluded to, and whose best plans of order, classification, discipline, and recitation may be utterly baffled or greatly promoted by the manner in which the school-house may be located, lighted, warmed, ventilated, and seated."

From this extract the reader will be able to form a fair idea of the high standard of school architecture which the author aims at introducing into practice, and so ably elucidates and advocates in the work before us. Estimating at its proper value the importance of the subject, who can say that the "standard" is too high in theory, or, with our mechanical and architectural aids, unattainable in practice? Admitting this, then, to be the standard, we can form some notion how utterly defective in almost every point of view have been the arrangements hitherto of our schools, whether in town or country. Generally they can best be described by negatives, by statements of what they are not. We have a shuddering recollection of the physical discomforts of one school-room, in which we were condemned to spend some portion of our early days,—"cribbed, cabined, and confined:" the suffocating sultriness of summer, the freezing frigidity of winter, were alike to be borne, softened only by the pleasing reflection that the school-hours had an end, and rendered tolerable only through the indifference and the hardihood of boy-time. In extending the causes of the frequent and dangerous illnesses which youths of both sexes are subject to during the period of what may be called their educational existence, have those originating in schools, or induced by their defective construction and arrangements, been taken into account, and the extent of their evil influence fully rated? We think not. Nevertheless, we are convinced that a well-devised investigation into the subject would result in eliminating some startling facts, and tend to show the extent and the virulence of the physical—and we may say, moral and intellectual—evils which are induced by the course we have alluded to. Defectively constructed and arranged schools have notoriously been the cause of sending to untimely graves many a father's pride and family's hope, who otherwise might have been spared. From our slight experience of the matter, we could compile a few notes which might form a chapter on a subject which deserves wide attention: we mean School Sanitation. Circumstances, unfortunately, prevent us from entering further into this important subject: in our next we hope to resume our remarks.

NOTES BY A PRACTICAL CHEMIST.

MANUFACTURE OF ALCOHOL FROM ASPHODEL ROOT.—It has been observed in Algeria that the tuberous roots of asphodel yield alcohol, on fermentation, in considerable abundance. Its exact source is unknown, since the roots appear to contain neither sugar nor starch. The yield is eight per cent., or double the amount obtained from beet-root. It is very possible that during the high price of alcohol, consequent upon the grape-blight, this new branch of industry may prove highly important.

* Report on Reaping-machines, by Mr. James Slight, Curator to the Society's Museum, —"Journal of Agriculture," January 1852, No. 35.

Steam-Boiler Incrustations.—M. Cousté proposes to get rid of these annoying deposits by raising the water employed to a very high temperature, 318° F., in a separate feeding apparatus, before introducing it into the boiler. By this means all calcareous salts held in solution are completely precipitated.

Electro-Deposition of Brass.—Copper being more easily reduced than zinc, peculiar arrangements are needful to precipitate both in the form of an alloy: we must either retard the precipitation of the copper, or hasten that of the zinc. To effect this, we employ a large excess of the latter metal. Heeren finds the following proportions completely successful:—Take sulphate of copper 1 part, warm water 4; sulphate of zinc 8 parts, warm water 16; cyanide of potassium 18 parts, warm water 36: each salt is dissolved in its stated amount of water, the solutions are then mixed, when a precipitate falls, which is either dissolved by water alone or by the addition of a little more cyanide. A slight turbidity is no injury. After the addition of 250 parts distilled water, it is subjected to the action of two Bunsen elements, charged with concentrated nitric acid mixed with one-tenth oil of vitriol. The bath is heated to ebullition and introduced into a glass with a foot, into which the two electrodes are plunged. The object to be coated is suspended from the positive pole, whilst to the negative a plate of brass is fixed. The two plates may be placed very near. The deposit is formed rapidly if the bath be very hot, and after a few minutes there is produced a coating of brass, which rapidly thickens. In this manner deposits have been obtained on copper, zinc, brass, and Britannia metal, all previously well pickled. Iron may perhaps also be coated in this way, but cast-iron is ill adapted for the operation. [Is not this process highly expensive?]

Briant's Process of Electro-Gilding.—The author employs the oxide of gold instead of the chloride, and decomposes with a very feeble current from a single Daniell's cell. About 800 grains of gold are dissolved in aqua regia, and the solution evaporated, in order to obtain the chloride dry and nearly neutral. It is then dissolved in 11 lbs. of hot water, with the addition of 1,550 grains of finely-powdered magnesia, and allowed to digest at a moderate temperature. The oxide of gold is found deposited in combination with magnesia. The precipitate is well washed, and treated with 11 lbs. of water acidulated with nitric acid in the proportion of 3 parts to 40. This liquid extracts the magnesia, leaving behind pure hydrated oxide of gold, which is freed from acid by washing upon a filter. To form the bath, Briant takes 7,750 grains yellow prussiate of potash, 1,860 grains caustic potash, 77,500 grains water, and having dissolved, adds the oxide of gold with its filter, and boils for 20 minutes. The oxide of gold dissolves, whilst peroxide of iron is thrown down. When cool, it is filtered, and a yellow liquid fit for use is thus obtained. The objects to be gilt should be well cleaned, and attached to the zinc pole of a Daniell's cell, whilst the other pole is connected with a platinum plate. The gilding may be effected either in a warm or cold solution, the former acting with greater rapidity, but less delicacy. An action of several hours is needed in order to obtain a durable coating. When the bath is exhausted, oxide of gold is again added, which produces a fresh precipitate of peroxide of iron. The gilding thus obtained is perfectly capable of being burnished, and likewise, if required, of producing a dead surface—a very difficult operation. In previous methods, dead gold was produced by the action of chlorine, and involved a loss of metal. Briant's process affords a perfect dead surface without any subsequent operations. The deadening is obtained as soon as the coating of gold has reached a certain thickness, and is more beautiful when the operation is carried on in the cold. The tint may be varied from a more reddish to a whitish shade by diluting the bath with a greater or lesser quantity of water. If the objects to be gilded are polished and brilliant, the deposit will also be brilliant, and it would then require a longer time and a thicker coating of gold to give a deadened surface. A deadened surface should, therefore, be communicated to the objects by previously depositing upon them a thin film of copper, after which they are carefully washed, first with water rendered alkaline, and then with pure water. In order to protect the parts not to be gilded, they are covered with gypsum, mixed with an alcoholic solution of lac.

Jacobi recommends also another process. He dissolves gold in nitro-muriatic acid, evaporates to dryness, and dissolves the residue in a solution containing 576 grains yellow prussiate and 144 grains caustic potash; the mixture is boiled for half an hour, filtered, and diluted with water enough to make up 5,290 grains. The bath will then contain—

	Parts.
Gold	1
Yellow prussiate	12
Caustic potash	3
Water	120

Note on Prussiate of Potash.—Liebig maintained that the prussiate melt contains no ferro-cyanide, but merely cyanide of potassium—an opinion which, on further examination, proves correct. The ferro-cyanide is only produced by the action of water and moist air upon the melt. This change is facilitated by the presence of caustic potash, and of finely-divided sulphuret of iron, if amorphous. If the latter has been rendered crystalline by the action of too high a temperature, its action is injurious. The lixiviation should be performed at from 158°—176° F.

ANSWERS TO CORRESPONDENTS.

"Junior."—Before attempting the decomposition of any of the "reputed elements," we would advise you to prove your strength in easier researches. Without a thorough mastery in analysis, you would become bewildered.

"Q. F."—The best test for soluble sulphurets is the nitro-prusside of potassium, or of sodium.

SPECIFICATION OF A DOUBLE DREDGER TO DISCHARGE OVER THE SIDE.

(Continued from page 13.)

BUCKET GEARING.

Spur Gearing and Shafting.—A spur-pinion 42 inches diameter, with teeth 8⅝ inches broad and 2½ inches pitch, turned on the ends and points, and dressed smooth and fair, to be keyed on crank-shaft, and drive a wheel 87 inches diameter, with cogs 8½ inches broad, made of the best hornbeam or beech, completely seasoned, well finished, and keyed up behind; the hem to be 4 inches deep, and the face and edges of it are to be turned; the mortise to be divided by a bridge ⅝ inch thick, but the cogs, although in two pieces each, are to join close and fair in the middle. This wheel to be provided with a friction-nave 60 inches diameter and 8 inches broad; the rim and edges of nave, face of flanges, and eye of wheel, to be accurately turned and faced; the amount of friction to be adjusted by eight pinching screws 1 inch diameter, with fine threads, screwed through nuts fitted into eye of wheel, and worked by capstan-heads against cast-iron slips fitted in recesses of the eye, and bearing on the periphery of the nave. The nave is to be keyed on intermediate shaft 7½ inches diameter, carrying also a boxed pinion 45 inches diameter, 8 inches broad, and 3 inches pitch, gearing with a spur-wheel 108 inches diameter, fixed with eight keys on upper tumbler shaft: this shaft to be forged square, planed parallel at the key-seats, and have journals 8½ inches diameter, working in lower brass bushes; the covers of which are to be set at an angle of 30 degrees. The first driving-pinion to be fast or loose, as may be required, by a clutch sliding on a feather in the crank-shaft, the clutch being worked by a long malleable-iron lever.

Dead Eyes.—The dead eyes to be of malleable iron, forged and finished to the proper shape, and strongly fixed both through the top table and the side.

Upper Tumblers.—The upper tumbler to be cast in one piece, with flanges 41 inches diameter over all, and 2½ inches thick at the edges, hooped on the outside with Lowmoor rings 2¼ inches broad and 3 inches thick, shrunk hot on outside of flanges, which are to be turned with a slight round, to fit corresponding hollow turned on hoop. The tumbler to be fitted with four bars, 5 inches square, forged from scraps, converted about ½ inch in all over, set to the proper distance for pitch of chain, passed through square eyes formed in the flanges, and fixed to them with eight keys at each end.

Lower Tumblers.—The lower tumbler to be five-sided, and consist of two cast-iron flanges, about 2 inches thick, strengthened with arms opposite to the four key-seats, and keyed on a cast-iron shaft, with chilled journals, 6½ inches diameter, working in cast-iron bushes, set in blocks at lower end of frame: the bars are to be cast in chill plates, pitched to proper distance for chains, and firmly keyed and bolted.

Bucket Frames. Sides.—The frame to be 77 feet long between the centres when the adjusting blocks are back; each side to be formed of a flat iron beam, 45 inches deep at the middle and 18 inches at the ends, composed of a vertical plate ⅝ inch thick, in not more than five lengths, and flanked on both edges with angle-iron, 4″ × 4″ × ⅝″, rivetted through every four inches with ⅞-inch snap rivets; the angle-iron to be in three lengths. The plates and angle-iron to be fitted close at the butts; the former to have flitches $\frac{5}{16}$ inch thick and 18 inches long, fitting close between angle-irons on both sides and all rivetted through, and the latter butt-straps curved to fit, 18″ long, and rivetted through, and proper bond to be made throughout. The flitches to be cut across the grain of the iron.

The upper edges of the beams to be covered with plates, 8 inches broad and ½ inch thick, rivetted on every four inches; and the lower edges to have straps 8 × ⅝″, fixed in the same manner and arranged so that the under plates of cross-ties will serve as butt-straps to them; the angle-iron butts being also so arranged that the back plates will serve as butt-straps to them also.

The butts of the rivets in the wake of the straps and roller brackets to be flush, and a bedding of oak laid between the two surfaces.

Cross Ties.—The cross-ties to have about 7 feet of space between each, the one at the lower end being placed as close as possible to the lower tumbler, and have an extra plate ½ inch thick to save it from stones, &c.; they are to be formed as hollow plate beams are, 15 inches wide, and the depth of the beam where they occur, having 3-inch angle-iron all round outside, ⅜ plates well rivetted and caulked; the ports left in them for closing being below and left open.

Straps.—The straps for lower ends of frame to be sound forgings, planed to the proper shape for seats to blocks of lower tumbler bushes, and have holes slotted in them for keys and bolts, and be held firmly together with screw-bolts through both; the upper straps to be made and fixed in the same way, and have grooves slotted for adjusting blocks, and be joined at the upper end by a malleable-iron bridge screwed on; the adjusting blocks to be of malleable iron planed to slide in grooves of upper straps, and worked by four malleable-iron screws, 2½ inches diameter at the body, and cut to ½-inch pitch, with a square thread bevelled towards the point at the back, and fitted with jam-nuts; the heads of the screws to be hexagonal, and worked by a two-handed wrench.

Rollers.—The rollers for carrying the bucket-chain to be of cast-iron, 1 inch thick at the body and ⅞ inch at the ends, 12 inches diameter, and as long as fill within 1 inch of the inside of frame; the axles to be 1⅞ inches square, fitted into eyes, 2¼ inches square, with four keys at each end with a bearing of 2 inches; the journals to be 1⅝ inches diameter, laid with steel, and hardened, and work in cast-iron bushes with hard-wood covers set in brackets attached to frame with two ¾-inch bolts to each, passing through oval holes, so that the rollers may be shifted a little up or down to keep on the bucket-chains.

Preventer Chain.—A short-link ⅞-inch chain to be made fast to an eye-plate at the lower ends of each frame, to lift the same should any part of the purchase give way; the loose end of it to be within 20 feet of the upper end of frame, along which it is to be temporarily lashed here and there, to keep it snug when out of use.

HOISTING GEAR.

A mitre wheel, 18 inches diameter, with teeth 4½ inches broad and 2 inches pitch, to be keyed on crank-shaft, and gear with a similar wheel on upper end of upright shaft; the bevel pinion on the lower end of upright shaft to be 12 inches diameter, with teeth 5 inches broad and 2¼ inches pitch, driving a wheel 24 inches on intermediate shaft, on which is also to be keyed a spur-pinion 12 inches diameter, boxed, working into a wheel 65 inches diameter, with teeth 5½ inches broad and 2¼ inches pitch. This wheel to have a friction-nave 42 inches diameter and 6 inches broad, fitted and finished similar to the friction of the bucket-gear. The journals of the upright shaft to be 4½ inches at the upper end and 4 inches at the lower, those of the intermediate shaft 4⅝ inches, shafting leading to barrel, and barrel-shaft itself 5¼ inches; the shafting leading to barrel to be in four lengths, passing through India-rubber packing in brass collars at the bulkheads, and supported on cast-iron stools bolted to floors. The after-end of this line of shafting to be turned, and have two feathers dovetailed into it for guiding and holding shifting-catch for coupling on to barrel-shaft; this catch to bear 8 inches on shaft, and have four snugs, 2½ inches deep and 5 inches long at the root, with a diminishing taper to the outside of ⅝ inch, made to fit the other half of the clutch, which is to be cast on the brake-wheel; the collar of the clutch to be turned, and have a forked lever, with steeled palms to work it; the end of the lever to stand 51 inches above the deck, and have a hinged locker to retain it in gear. The brake-wheel to be 45 inches diameter, and 4 inches broad within the lists, which are to be ½ inch broad and ⅞ inch deep, all turned and faced. The straps to be made of the best rolled-iron, 4 inches by ¼ inch, and lined with beech, in staves 4 inches by ¾ inch, each fixed with two screws, and two additional ones at the ends, all inserted from the outside; the joints for lever and adjusting screws to be firmly rivetted to straps, accurately bored or turned, and the adjusting screw made 1¼ inch diameter, and finely threaded; the fulcrum-bracket to be strong, and firmly fixed; the joints to be made 3 inches apart centres, and the friction is to be commanded by a weight suspended from a compound lever sufficient to sustain the frame.

The barrel to be 6½ feet long over the flanges; the body 30 inches diameter, and the flanges 32 inches; the eyes to be square and fixed on shaft, with eight keys at each end.

The purchase to consist of three lower, and as many upper sheaves, and a chain. The block to have strapped frames with strong bridges, and suspended by a heavy jaw and pin to a square bolt fitted to beam overhead, passing through same, and strongly keyed above; the sheaves to be 15 inches diameter, with an elliptical groove for chain, all turned, faced, and bored; the coaks bushed with soft steel, and revolve on a pin 2 inches diameter, steeled and hardened.

The lower block to be formed similar to the upper one, and have the frame formed to sustain a forged cross-head. The side-rods to be 2½ inches thick, 3½ inches broad near the ends, and swelled to 4½″ at the middle; the ends to have reverse jaws to fit cross-head, and snug forged on lower strap. The pins of the joints to be 2½ inches diameter.

The fall to be one length of short-link chain, 1 inch diameter, two turns being left on the barrel when the centre of the lower tumbler is in 24 feet water.

PITCH-CHAIN AND BUCKETS.

Each bucket-chain, when complete, is to have on it 41 buckets, each of which requires two pairs of links rivetted on itself, two single links, and four pins and cutters; the distance between the centres of the pins, otherwise called the pitch, being 2 feet.

The backs of the buckets to be of Lowmoor iron, ½ inch thick; the body $\frac{5}{16}$ inch, and bottom ¼ inch thick, and of Govan best plates, or others equal; water-holes to be punched where required, and the whole to be rivetted about 2¼ inches apart centres, and caulked; the mouth-pieces to be 1¼ inch thick at the point, and taper to ½ inch at the ends, and laid with a strip of steel at the forge, 36″ × 2″ × ½″, the three rivets at the ends being made flush.

The bucket-links to be rolled from Lowmoor iron, T shaped, 3 inches deep, 5 inches broad on the head, and 1¾ inches at the feather, on each side of which washers are to be welded to assist in forming the eyes; each link to be fixed to bucket-back with ten Lowmoor rivets, ⅞ inch diameter. The single links, forged from fine scrap, to be 3 inches square at the body, and have forged eyes to fit between each pair of bucket-links. The eyes to be bushed on the wearing side with spring-steel about ⅜" thick at the middle, and tapering to nearly an edge at the ends, the steel extending about three-fourths round the eyes, and be solidly welded thereto: for a trial, the eyes of twelve of the single links are to be bored out to a uniform size to receive thimbles of spring-steel ¼ inch thick, butt-jointed, and driven in while the iron is hot, leaving an eye, when cold and ready for work, of a proper size to receive pins 2¼ inches diameter. The pins are to be made from octagonal bars of fine scrap-iron, laid with steel ⅜ inch thick for a length of 3½ inches at the bearing, and finished to a diameter of 2¼ inches; have five-sided heads at the one end, bearing on snugs to prevent turning in the bucket-link, and a split-cutter at the other.

Note.—In the above description of the bucket-gearing, hoisting-gearing, and bucket-chains, the quantity for one well only is described; but as there are two wells, double the quantity will be required, *i. e.* two sets of bucket-gearing and frames, two bucket-chains, two purchases, two barrels, two sets of shafting, wheels, &c.

FORWARD MOTION.

The motion for dragging the vessel ahead when working is to consist of gearing driven by the starboard lying-shaft, with change-wheels for working the crab at different speeds, as the nature of the ground may require.

The drivers keyed on the lying-shaft to be 38", 28", and 18" diameter respectively, and gear with followers 12", 22", and 32" diameter, all 4" broad and 1⅜" pitch; the lying-shaft to have a bearing raised on it as large when turned as the diameter of the ruffs, to have a groove slotted in it, and on which to key a cast-iron boss, bored, turned, and slotted for shifting the drivers into gear with the followers; these are to be keyed on a shaft 2½" diameter, with a pair of spur-wheels 28" diameter, to communicate the motion to the shafting leading to the bow-crab, and in one of which is to be fitted a friction 16" diameter, similar to that described for cog-wheel; the shafting leading to crab to be 2¾" diameter, hung in brackets fixed to deck-beams, and have 14" mitres where required for the turns.

BOW-CRAB.

The bow-crab to be double-powered, and have strong cast-iron cheeks firmly secured to deck-beams; the shafts to have journals, 5 inches long, with double ruffs, running in brass bushes: the first shaft to be 2⅝ inches; the intermediate, 3 inches; and the barrel-shaft, 3½ inches. The first pinion 7" × 4" × 1⅜", next 7" × 4¼" × 2". The first wheel 21 inches, that on the barrel-shaft 36 inches. The barrel to be 12 inches diameter at the body, and curve to 28 inches at the flanges, over which it is to be 36 inches long, and have turned snugs 12 inches diameter, cast on ends of barrel, on which the barrel-wheel and ratchet are to be keyed. The ratchet to be of malleable iron, 16 inches diameter and 2 inches broad, shrunk on hot, and checked by three malleable-iron palls, which may be held out of gear at pleasure by a lever and handle.

The barrel to have grooves cast on it to receive six malleable-iron whelps, fixed on with counter-sunk screws tapped in; a guard to be fixed on frame to prevent the chain falling on the ratchet; and a friction-brake complete is to be keyed on the intermediate shaft. A cast-iron surging-head to be fixed on that end of the barrel-shaft remote from the power. The crab must be designed so that it may be worked in either power by the engine or hand; it will therefore require two crank-handles, 16 inches pitch, on a spindle 1½ inch diameter, on which are to be keyed two pinions of the diameters and pitches necessary to gear into the opposite wheels. A slip-clutch and handle to be fitted on the first power-shaft, catches where required, and the tie-rods so arranged as not to interfere with the free working of the attendant.

DONKEY-ENGINES AND STERN MOTION.

The stern-crab to be so designed that it may be worked by hand, or, when required, by the donkey-engine. The donkey-engines to be non-condensing, and consist of two cylinders, each 10 inches diameter, with valve-gearing complete; the cranks set at right-angles to each other, so that they may be started or stopped without the engineer leaving the starting-platform: the crank-shaft to have a fly-wheel keyed on it, and a bevil pinion 12 inches diameter, 3 inches broad, and 1½ inch pitch, driving a wheel 48 inches diameter, keyed on the end of a lying-shaft 2 inches diameter, passing along roof of cabin, and enclosed in a neat case, with doors for lubricating the journals. The after end of this shaft to communicate motion to an upright shaft, same size, by a pair of mitre-wheels, 12" × 3" × 1½"; after which the gearing is to be similar to that described for the bow-crab.

(*To be continued.*)

ON AN IMPROVED MODE OF PRODUCING DRAFT IN MARINE BOILERS BURNING ANTHRACITE COAL.

By J. Vaughan Merrick.*

(Patented May 6th, 1854.)

The use of anthracite coal in marine boilers depending on natural draft for combustion, is attended with the difficulty that in smooth, calm weather, or light favourable winds, or at the time when circumstances favour a rapid passage, the draft is deficient, and the supply of air to the fire-rooms diminished, causing a reduced production of steam. What is termed "natural draft," is traceable to two causes: 1st. The rarefaction due to the elevated temperature of the gases in the chimney; and, 2nd. The influence of winds &c., in supplying air for combustion, or in their effect on the contents of the chimney. It is this latter element which is so variable, and which has generally caused the introduction of blowers for use in calm weather.

These blowers are generally placed below, in the fire-rooms, or between the boilers, and the nozzles conduct the air below the fire-room floors into channels leading under each furnace-door. These channels are provided with traps, by which they may be shut off when fires are cleaned. Now, the use of blowers with forced blast is attended with serious inconveniences, among which are—the great power expended in driving them; a rapid destruction of the furnaces, caused by the intense local heat; waste of fuel, expense of construction, &c.: besides which, it is requisite to raise the boilers high enough to get the air-channels under the floor, which, with return tubular boilers, is a serious evil. These objections, which may fairly be advanced against blowers, cannot be charged against exhausting fans, which produce an effect similar to that of natural draft.

Exhausting fans are not a new device for the purpose of producing draft. Peclet describes and illustrates a plan for using them in stationary boilers. Captain Ericsson also used them, and applied one to the auxiliary screw-steamer *Massachusetts*, which is the only case within my knowledge wherein they have been employed in marine boilers.

About ten months ago, it became an object to increase, at times, the evaporative power of the boilers of the steam-ship *Keystone State*, which, although amply large in ordinary weather to carry high steam, would not supply to the required extent in calm weather. The use of fan-blowers for forced blast was considered objectionable, for reasons previously given. The use of steam-jets was not advisable, as the engine has a fresh-water condenser. The only remaining plan was an exhausting fan. But it was necessary to have this fan so arranged, that when not in use, the boilers should be in their original condition, and that when in use it could be easily accessible. The plan adopted by Captain Ericsson in the *Massachusetts*, where the blower-case was built in the body of the chimney, does not fulfil either of these conditions; besides which, the chimney of the *Keystone State* was already in place; and, whatever plan was adopted, had to be applied in a very limited period of time. To fulfil all the desired conditions, I designed the arrangement hereafter described; and, in order to show the effect produced by the fan, have waited till a careful experiment could be made, of which the results are given below.

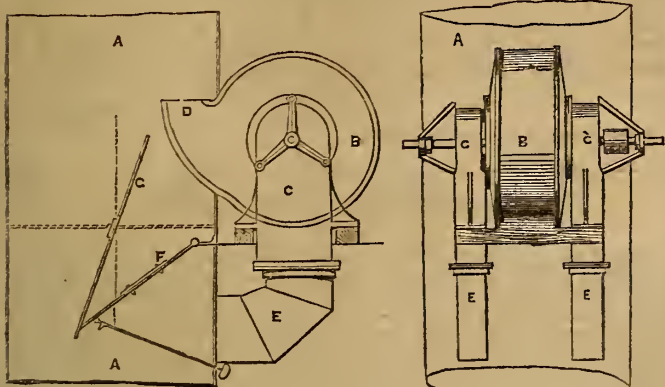
The fan is 4 feet diameter, 2 feet wide, with passages 2 × 2 feet; is supported on the hurricane-deck, and placed forward of the stack. It is driven at about 500 revolutions per minute by a vertical non-condensing engine, with cylinder 8 inches diameter, and 1 foot stroke, the belt carried round the fly-wheel; the engine makes one revolution to five of the fan. The whole space occupied by fan, engine, belting, &c., is 8 feet square, and the whole of the machinery is protected by a house, similar in appearance to the pilot-house. It has been in use whenever required, since January last, and was entirely successful in the object

---

* From the "Journal of the Franklin Institute."

for which it was put up. As the number of revolutions of the fan is limited, the evaporative power of the boilers would not be increased in head-winds. But its effect in smooth weather is exactly what was intended, viz., to supply the deficiency of draft. Of course, it is not claimed that the economical efficiency of the boilers is increased, but simply their evaporating power.

Description.—The fan of the *Keystone State* is represented in the accompanying illustration :—



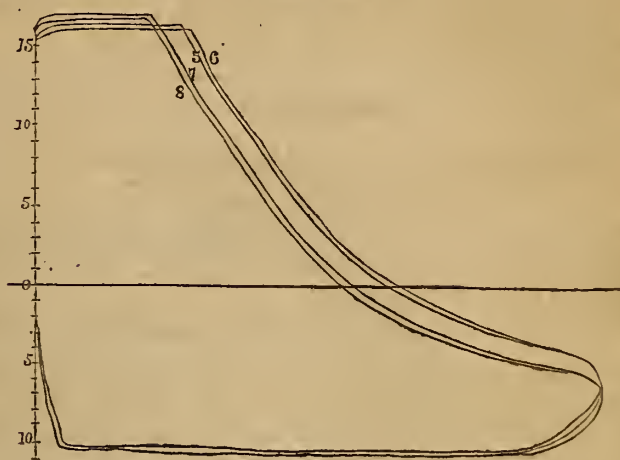
References :—
A, smoke-pipe.
B, fan
C C, inlet boxes.
D, outlet.
E, inlet pipes.
F, hinged valve, or deflector.
G, damper of stack.
H, handle for regulating inlets, &c., of fan.

When the fan is out of use, the valve, F, is lowered to the position shown in dotted line, against the forward side of the stack, covering the inlet openings, E, to the fan, and shutting it off, so that it is not heated by the passage of the gases, &c., and may be oiled or adjusted; while the damper, G, is placed so as to regulate the draft, as usual.

When the fan is in use, the valve, F, is raised to the position indicated in full lines, the damper, G, placed vertically, or nearly so, its lower side being against the valve. The ascending current is thereby divided into two portions. That on the forward side striking the valve, is deflected into the fan, whence it is ejected upwards at an increased velocity into the stack, thus forming a current which draws with it the other portions of the gases, passing up the after-side of the stack, and the whole mass has its velocity increased, or, in other words, the natural draft is intensified.

Results obtained.—To ascertain how much the evaporation was increased by this device on board the *Keystone State*, the engineer chose a day of settled weather, with very light winds on the quarter, and ran the fan one watch of four hours, noting the whole number of revolutions made by the engine, and maintaining a uniform (or nearly so) pressure of steam in the boilers, by adjusting the cut-off; at intervals of 45 minutes, four indicator cards, marked 1, 2, 3, and 4, were taken, an average of which will give the mean performance throughout the whole period. The blower was then thrown off, and the same particulars noted for the next four hours, the four cards marked 5, 6, 7, and 8, being taken at similar intervals. An inspection of these diagrams will show that during the use of the fan, the cut-off had constantly to be lengthened, showing that the fires were improving; while, during the last watch, the cut-off had constantly to be shortened, showing that although the fires were left in good condition, they were constantly deteriorating. It is evident that a more prolonged trial would have shown an apparent gain by the use of the fan, much greater than that obtained.

Indicator diagrams taken on the engine of the *Keystone State*, Oct. 28th, 1854. Cylinder—diameter 80 inches; stroke, 8 feet; dip of wheels, 4 feet 7 inches; temperature of hot-well, 120°.



Cards.	Time.	Steam in boilers, in pounds.	Vacuum per gauge, in inches.	Avg. revols. per minute.	Cut-off in feet.	Initial pressure in cylin.	Mean press. in cylindr.
			With the Fan.				
No. 1.	9·15 A.M.	18	24	15·60	2·33	16·25	17·36
No. 2.	10 „	17·75	24	15·65	2·55	16·50	18·40
No. 3.	10·45 „	18·50	24	16	2·60	17·25	18·98
No. 4.	11·30 „	18·50	24	16·14	2·80	17·33	19·91
Means		18·19	24	15·69	2·57	16·83	18·66
			Without the Fan.				
No. 5.	1·15 P.M.	18	24	15	2·00	15·75	15·80
No. 6.	2 „	18	24	15	2·20	16·25	16·10
No. 7.	2·45 „	18	24	14·50	1·65	16·50	15·17
No. 8.	3·30 „	18	24	14	1·60	16·75	14·88
Means		18	24	14·90	1·86	16·31	15·49

Revolutions during first watch, 3,766; during second watch, 3,575.

Comparison.—To compare these results, it is evident that we must compare the amounts of water evaporated, which are in proportion to the number of revolutions, and the portion of stroke performed before steam is cut off (added to the clearance), divided by the volume of steam at the initial pressure given in the last column but one of the above tables.

This clearance at each end of the piston amounts to 0·23 feet, by the area of the piston. Hence we have—

$$\text{With the fan } \frac{3766 \times (2{\cdot}57 + {\cdot}23)}{840} = 1255.$$

$$\text{Without the fan } \frac{3575 \times (1{\cdot}86 + {\cdot}23)}{853} = 870.$$

The numbers 840 and 853 being the respective volumes of steam at 16·83 and 16·31 lbs. per square inch.

Then 870 . 1255 : : 100 : 1·44, or, gain for whole period, 44 per cent.

To show the comparison at the time of the last observation in each watch, which would be more nearly a criterion than the mean performance, we have (taking the average revolutions per minute, instead of the total number),

$$\text{With the fan } \frac{16{\cdot}10 \times (2{\cdot}80 + {\cdot}23)}{829} = 0{\cdot}5880.$$

$$\text{Without the fan } \frac{14 \times (1{\cdot}60 + {\cdot}23)}{841} = 0{\cdot}3046.$$

Then, 0·3046 : 0·5880 : : 1·000 : 1·927; or, the evaporative effect was nearly *doubled*, and the speed of the ship (engine) increased as 14 : 16·10, or about two statute miles per hour. In the above calculations, no account is taken of the steam used by the engine driving the fan, which may be estimated as equal to about one-fourth the main cylinder full of steam per minute, and would amount to about 2½ per cent. in the first, and 2 per cent. in the second case.

It is not claimed that these results would be at all extraordinary if produced by blowers in the usual manner; but when it is considered that they are produced with a very trifling expenditure of power, without waste of fuel, without any destructive influence on the furnaces—that both the fires and the blowing machinery are perfectly accessible for cleaning at all times, and, in short, that all the well-known advantages of natural draft are combined with the power of nearly doubling the evaporation in calm weather, I think the results show an improvement sufficiently marked to be worthy a place in this *Journal*.

CORRESPONDENCE.

THE COMBINATION OF METALLIC AND ELASTIC SUBSTANCES FOR PISTON-PACKING.

To the Editor of The Artizan.

Sir,—Will you permit me to confirm the testimony given in your last number, by Messrs. Hoey, Kennedy, and MacGregor, relative to the employment of vulcanised India-rubber in conjunction with metallic packings for pistons of steam-engines?

About two years ago, I took a piece of the best India-rubber I could get, which I cut in two pieces. One piece was suspended in the valve-box, and the other was employed as packing to piston. The engine was worked about a week, and, on examining it, I found the India-rubber in the piston entirely dissolved, while that in the valve-box remained unaltered, although the working pressure was about 50 lbs. per square inch. The cause of failure in this case could not therefore arise from inferiority of material, and I then came to the conclusion that it was the introduction of *oil* and *tallow* into the cylinder which caused it to dissolve, neither of these lubricators having been introduced into the valve-box. I have also frequently observed the India-rubber suction-hose for the pumps of portable steam-engines entirely dissolved at such places where the oil used for the engine has fallen upon it; and this has taken place when the hose has not been subjected to any heat whatever, being merely used to convey cold water to pump.

I remain, Sir, most obediently yours,
John Pinchbeck.

Reading, January 8th, 1855.

From Charles Macintosh and Co., Patentees of the Vulcanised India-rubber.

To the Editor of The Artizan.

Sir,—Our attention has been called to a letter in the Artizan for this month, signed "Hoey, Kennedy, and MacGregor," stating that they had introduced vulcanised India-rubber behind the metallic packing-rings of the piston of a steam-engine, but before it had worked a month they had to take it out again, as it had become so far dissolved as to completely glue together the piston-springs and junk-ring, and coat the inside of the cylinder, so that the engine would not move, &c.

We beg to state, for the information of your readers, that India-rubber, properly vulcanised and manufactured, is a most efficient material for this purpose. We are in the constant habit of supplying it to engineers for locomotive pistons, where it is far more severely tested than in the case of failure alluded to above; and the conclusion we draw is, that Messrs. Hoey, Kennedy, and MacGregor had used vulcanised India-rubber that had not been manufactured especially for the purpose to which they applied it.

To illustrate the extremes of vulcanisation, we enclose two specimens of India-rubber manufactured at our works; the one hard and consistent as horn, and without elasticity; the other, a highly elastic thread.

Both these articles are, or may be, made from the same raw material; but the processes of manufacture that they have undergone are widely different.

We are, Sir, your obedient servants,
Charles Macintosh and Co.

Manchester, 16th January, 1855.
Cambridge-street, Oxford-street.

MUNTZ'S PATENT YELLOW METAL.

To the Editor of The Artizan.

Sir,—I have read with much satisfaction the letter of Mr. R. Armstrong in your last number, and quite agree with him that an investigation into the chemical changes which Muntz's metal undergoes is most desirable. I have frequently noticed the extreme brittleness of the sheathing and bolts when stripped off vessels, and offered to brass-founders in this town and elsewhere for re-melting. The ductility of the metal is so totally destroyed that it will scarcely command a sale at any price, while old copper sheathing finds usually a ready market. Experiments on a large scale are now being made with tubes for locomotive and marine boilers of the patent yellow metal, where they are being freely taken from their cheapness; but I anticipate, in the course of a year or two, the same results will follow with the tubes as with the ship's bolts; and although we may not hear of passenger-trains being "never heard of," the sudden failure of one or more tubes in a locomotive boiler may endanger the lives of many of her Majesty's lieges, and cause a railway accident the most appalling in its consequences.

I am, Sir, your obedient servant,
A Brassfounder.

Birmingham, January 18th, 1855.

ROYAL SCOTTISH SOCIETY OF ARTS.

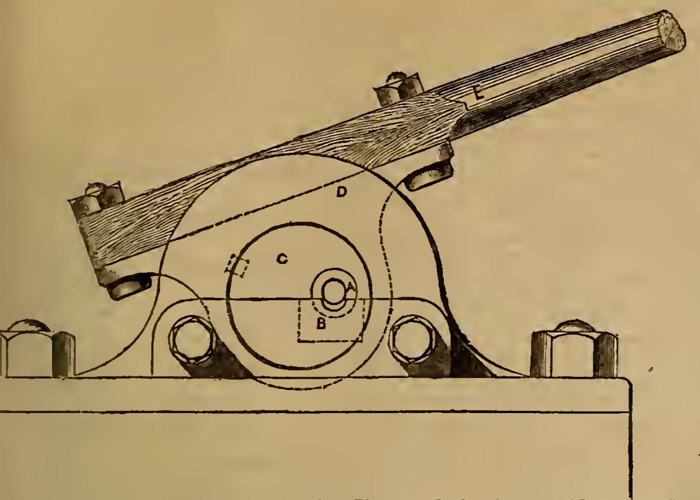
November 27, 1854.

Description of a Tool-holder, applicable particularly to the screwing-lathe constructed by Mr. George Taylor, Imperial Mint, Constantinople. This was exhibited and described by Mr. Sang, V.P.—The tool-holder consists of a steel stock, squared for the purpose of being secured in the slide-rest. It is pierced through its whole length, and is sawn up from each end to near the middle. The bore thus prepared receives a cylindric stock, having at the end an oblique piece, through which is worked a hole, triangular or round, according to the nature of the cutter. Into this hole the cutting tool is passed until the cutting edge lies at the height of the lathe centre. In order to secure the cutter in its place, there is a small screw worked by capstan-holes and pressing upon the back of the cutter. The head of this screw is placed in a recess so as to be out of the way of the work, and yet conveniently reached by means of a bent tommy; and as this arrangement requires no split in the stock, that sliding of the cutter which often takes place in Holtzapffel's tool-holder is avoided. The cylindric stock admits of being turned round so as to incline the direction of the cutter to either side, for the purpose of following the slope of a right or left hand screw. At the same time, the split in the square stock allows the slide-rest pinching screws to bind the cylinder firmly in its place, while they secure the square stock.

Design for a Chronofore, or improved Hack Watch, for minutely subdividing a second. By Edward Sang, Esq., V.P. Explanatory experiments were exhibited.—The author stated that this instrument, which he called a chronofore, or time-carrier, is intended to be used in the comparison of clocks and chronometers with each other. Every one who has tried to compare two chronometers must have felt the difficulty of estimating that fraction of the beat by which the one may be in advance of the other, and that the nearest half-second is almost the limit of our power. In order, then, to obtain the rate of the chronometer, we are compelled to allow it to go on for a considerable time, even for several days; and after all, it is only the average rate for that time which is got. The mode of comparison proposed by the author is to use an intermediate watch, or rather chronometer, and to compare this with each of the time-keepers whose relative rates are to be observed; and to arrange the beats of this intermediate or hack watch, so as to allow of comparison to a minute fraction of a second. For this purpose the hack-watch is constructed to make one beat per minute more or less than the usual number of beats—say 119 in place of 120 beats. In this way we are able, just as with the Vernier and scale, to compare the position in time of our watch with that of the chronometer; and comparing it again with a second chronometer, we get the difference between the two, true to the 238th part of a second, if the ear can go to that nicety, or otherwise to the utmost degree of precision to which the ear can attain. When the chronofore is compared with a clock beating whole seconds, the accuracy attainable by it is only the 119th part of a second; but even this precision is at the very limit of the delicacy of the ear. It was remarked that by this method there would be much saving of time in rating ships' chronometers—a thing of vast consequence both to the royal and mercantile navy.

Description of an Improved Boring Machine for Blasting Rocks. By Mr. Hugh Cleland, smith at Craigleith Quarry, near Edinburgh. A model and drawing of the machine were exhibited.—This machine has been in use in Craigleith and Redhall Quarries for four years, and gets the highest character from Mr. Johnstone and Mr. Gowans, who have used it. It is of simple construction, can work at any angle as well as at the perpendicular, is not liable to be deranged even when worked by the most ignorant hands, and during the four years it has been in use has required no repair except the sharpening of the borer. The machine is formed of a timber frame, axle, crank, and fly-wheel. The crank is part of a circle, is hollow, with steel rollers set in it, which act on the under side of a metal flanch fixed on the boring-rod by a steel key—which flanch is shifted up the boring-rod eight or nine inches at a time, as the boring proceeds, without much hindrance or difficulty. The crank, in lifting the boring-rod, by acting on the under part of the flanch, turns the rod a quarter round every lift. The fall of the boring-rod is two feet; it may be from 20 to 50 feet long, and 2⅜ inches in diameter. The mouth-piece, or borer, at the end of it, is so constructed as to form a perfectly round hole 4½ to 7½ inches in diameter, or much larger if required. It is worked by three or four men, and in ordinary cases bores from ten to fifteen feet per day. This machine has bored to the depth of forty feet. Much larger masses of rock can be loosened with the same quantity of gunpowder than by any method of boring before in use. The author stated that the cost of the machine does not exceed £20, whereas the price of the American one was £50.

NOTES AND NOVELTIES.



How's Patent Machine for cutting Bolts, Rods, Spindles, Wire, &c.—The engraving represents a side elevation of this machine, which consists of a cast-iron base-plate and bearing, D, to which is attached the die-rest by two studs. The die B may be removed and replaced by a larger or smaller one as required. In the bearing D is the disc C, containing the circular die A, which, as in the case of the die B, may be removed and substituted at pleasure. The bar or rod to be cut is introduced through this aperture of the die A, to the distance required; the lever E being depressed, the bar is cut by the pressure and cutting action of the dies A and B. The advantages of this machine are, that it is simple in construction, inexpensive, occupies but little space, and will not easily get out of order. The facility for using several sizes of dies in the same machine is an especial convenience.

Manufacture of Resin-oil.—A sample of resin-oil, a product comparatively new as regards its manufacture on a commercial scale, was exhibited by A. Miller and Co., of Newborn, North Carolina. This is obtained from the resin of the *Pinus sylvestris*, a tree found abundantly growing in the vast swamps of North Carolina. The usual process of distillation at a low temperature is first resorted to, by which the turpentine is obtained, and the residue is the common resin of commerce: from this the resin-oil is now manufactured on a very extensive scale, four establishments being in operation in New York, Philadelphia, and Delaware, averaging together 120 barrels per day, with an increasing demand. Through the courtesy of the President of the American Resin-oil Company, I had an opportunity of seeing their works in operation. The process of manufacture was as follows:—The resin used was the yellow, second quality, costing from 1 dollar 55 cents to 1 dollar 75 cents per barrel of 320 lbs. gross weight. This was thrown into stills, having a capacity of from 30 to 40 barrels each, and being heated by a small fire, just sufficient to melt the resin, which was gradually added. After a certain interval (a few hours) the head of the still is luted on and the fire increased; distillation then commences. A small quantity of water mixed with an acid comes over first; this is succeeded by a proportion of naphtha, and lastly the oil itself comes over, leaving behind in the bottom of the still a black pitch-like residue, which is withdrawn by the plug-holes. The whole operation requires about 14 hours for fine qualities of oil; if it is forced on faster, the quality is deteriorated. The average produce per barrel of resin, 300 lbs. net weight, is thus made up: water and acid, 2 gallons; impure naphtha, 5 gallons; resin-oil, 16 to 18 gallons; pitch, 2 to 3 gallons. The water and acid are not utilised. The naphtha sells readily at 18 cents per gallon for burning and manufacturing purposes. The oil sells for 35 cents per gallon for first quality, and 23 cents to 30 cents per gallon for second quality. The best is used extensively for dressing wools, &c., and for adulterating finer oils; the second quality, for adulterating cheaper oils, for tanners, curriers, &c., and in combination with a small proportion of fatty oils it forms a capital lubricant for railway and general machinery purposes. The pitch is used chiefly for ship-work and for outside-work, and is sold at 1 dollar 60 cents per barrel. The oil requires re-distilling once or twice, according to quality. This is done in common stills, into which a jet of steam is thrown during the process. After the last distillation, it is carried over into large open iron tanks, and there mixed with half its quantity of water; heat is applied, and their contents are allowed to boil until all the water is evaporated. This is called bleaching it, or rendering it fixed.—*Prof. Wilson's Report on New York Exhibition.*

India-rubber Air-pump Valves, with metallic hinges, have been used in America in the *Golden Gate*. This ship has oscillating engines, with puppet-valves and "Allen's adjustable cut off."

On the Formation of Brass by Galvanic Agency.—Copper is more electro-negative than zinc, and separates more easily from its solutions than a metal less negative. If, then, in order to obtain a deposit of brass galvanic means, we employ a solution containing the two component metals copper and zinc in the proportions in which they would form brass, there will only be produced by the action of the battery a deposit of real copper: the zinc, more difficult of reduction, remains in solution. What must be done, then, to obtain a simultaneous precipitate of the two metals in the proportions required, is either to retard the precipitation of the copper, or to accelerate that of the zinc. This may be effected by forming the bath with a great excess of zinc and very little copper.

Dr. Heeren gives the following proportions as having perfectly succeeded:—

There are to be taken of	Sulphate of copper..........	1 part.
	Warm water................	4 parts.
And then	Sulphate of zinc	8 ,,
	Warm water................	16 ,,
	Cyanide of potassium........	18 ,,
	Warm water................	36 ,,

Each salt is dissolved in its prescribed quantity of water, and the solutions are then mixed; thereupon a precipitate is thrown down, which is either dissolved by agitation alone, or by the addition of a little cyanide of potassium: indeed, it does not much matter if the solution be a little troubled. After the addition of 250 parts of distilled water, it is subjected to the action of two Bunsen elements charged with concentrated nitric acid mixed with one-tenth of oil of vitriol. The bath is to be heated to ebullition, and is introduced into a glass with a foot, in which the two electrodes are plunged. The object to be covered is suspended from the positive pole, whilst a plate of brass is attached to the negative pole. The two metallic pieces may be placed very near.

The deposit is rapidly formed if the bath be very hot: after a few minutes there is produced a layer of brass, the thickness of which augments rapidly.

Deposits of brass have been obtained in this way on copper, zinc, brass, and Britannia metal: these metals were previously well pickled. Iron may, probably, also be coated in this way; but cast-iron is but ill adapted for this operation.—*Mittheilungen des Hannov. Gewerbevereins*, through *Bulletin de la Société d'Encouragement, No.* 16, *August* 1854.

New Process for Engraving on Zinc.—M. Dumont, an engraver, (Rue Dauphine, 17,) describes, under the name of Zincography, a process for electric engraving which is promising. Upon a thick plate of zinc planed and grained with a steel tool and fine sand, he draws any subject with a kind of lithographic crayon; upon the design, when finished, he sprinkles a fine powder, mixed with resin, Burgundy pitch, and bitumen of Judea; by heating the zinc plate he melts this powder, which is converted into a varnish, and spreads over the parts of the surface which have been covered with the fat crayon, that is, on everything which constitutes the design. To bite in the plate, and obtain the design in relief, he plunges it, while in connexion with the positive pole of the pile, into a bath of sulphate of zinc, in face of another plate connected with the negative pole; the current passes and corrodes the zinc which is not covered by the ink, and thus the design is brought out. From the plate thus engraved in relief, a gutta-percha mould is taken, in which copper is deposited to obtain the engraved plate, from which proofs may be taken by the ordinary typographic press. The process invented by M. Dumont is a new application of the principle first applied by M. Beuvière, and which M. Baldus has successfully used in his attempts at photographic engraving.—*Cosmos*, vol. v., p. 292.

New Process for Papermaking.—An excellent process for making pulp for paper and pasteboard, from wood, was invented a short time ago by M. Hartmann. This process has been perfected by M. Schlesinger, who has established a manufactory in England, where his methods have great success.

The apparatus which he uses is composed essentially of a very strong frame of wood or cast-iron, presenting an arrangement similar to that of the boxes or troughs of the grindstones used in workshops, with the difference that the trough is circular only on one side, at its lower part, the other side being rectangular, with an opening in the angle for the drainage of the water and pulp, which falls into a reservoir below as it is produced. A millstone, well roughened upon its circumference, is placed on a horizontal axis resting upon two journals placed one at each side of the trough; a rotary motion is given to the axis in any of the ordinary ways, and the wheel turns like a common grindstone.

The blocks of wood, after being cut of the proper dimensions, are placed in boxes and pressed by rods worked by counter-weights perpendicularly to the millstone, so that the blocks are always in contact with the stone which tears the fibre, and in such a way that their fibres are always parallel to the circumference of the millstone. By this means, a pulp is obtained which is equal to the ordinary rag-pulp, and cheaper. But this pulp has the property of absorbing a greater quantity of mineral substances, without lessening the strength of the paper. The pulp from hard or soft wood may be stained, and will take the most delicate tints, as well as the paste from rags.

According to the calculation of M. Schlesinger, he can produce a kilogramme of *dry* pulp from wood for 10 centimes (about 1·00 dollars) per cwt.; and he does not doubt that in countries where wood and motive power are cheaper, he can prepare it for 7 or 8 per cent. per kilog. The cheapest woods, such as the fir, pine, poplar, willow, &c., answer best for this purpose. According to the experiments made, the following articles may be advantageously made: 1st. Packing-paper of the first quality, with a mixture of 70 or 80 per cent. of the wood-pulp, and 20 or 30 per cent. of rags; 2nd. Common wrapping-paper, with 50 per cent. of wood-pulp; 3rd. Writing-paper, from the common to the first qualities, with from 40 to 60 per cent.; 4th. Wall-paper, with from 80 to 100 per cent.; 5th. Card-paper, 20 per cent. of the wood-pulp; (this material is the best for making the joints of steam-pipes, when it is all of the wood-pulp;) 6th. Printing-paper for journals, which will stand the highest temperature, from 60 to 75 per cent.; 7th. Pasteboard of superior quality with 60 per cent., the quality diminishing to 100 per cent. A quality made with 75 per cent., and 25 of the rag-pulp, was tried for cards for the Jacquard loom, and resisted the tests of heat and dampness.—L. d'Aubreville, *Cosmos*, vol. v., p. 295.

DIMENSIONS OF STEAMERS.

THE BERGEN STEAM NAVIGATION COMPANY'S NEW IRON PADDLE-WHEEL STEAM-VESSEL "NORGE."

Built and fitted by Messrs. Thomas Wingate and Co., engineers and iron shipbuilders, White Inch, Glasgow, 1854.

Builders' measurement.	ft.	inches.
Length from figure-head to taffrail	196	0
Ditto of keel and fore-rake ...	180	11
Breadth of beam	25	6
Ditto over the paddle-cases ...	41	0
Tonnage.	Tons.	
Hull	$580\frac{12}{94}$	
Engine-room	$156\frac{9}{94}$	
Register	$424\frac{3}{94}$	
British Customs' Act (for foreign vessels).	ft.	tenths.
Length on deck	179	5
Breadth (under the deck)... ...	24	7
Depth of hold (deck to skin) ...	15	0
Length of poop	47	0
Breadth of ditto	19	8
Depth of ditto	6	7
Length of wing of poop	3	7
Breadth of ditto	5	0
Depth of ditto	6	4
Length of engine-space	44	9
Tonnage.	Tons.	
Hull	$511\frac{36}{100}$	
Poop ... ... $65\frac{03}{100}$ tons; Wings of do., each $\frac{102}{100}$; both ... ... $2\frac{04}{100}$ "	$67\frac{07}{100}$	
Total	$578\frac{43}{100}$	
Contents of engine-space	$180\frac{00}{100}$	
Register	$398\frac{43}{100}$	
Hamburgh Customs' Act	147 lasts	
Norwegian Customs' Act (commercial)	178 ditto	

Fitted with a pair of oscillating engines of 180-horse nominal power; diameter of cylinders, $50\frac{1}{2}$ inches; length of stroke, 4 feet 6 inches. Has two inclined air-pumps. Paddle-wheels—diameter, extreme, 19 feet 5 inches, and 18 feet 10 inches effective: 18 floats—length, 6 feet 10 inches; breadth, 2 feet. Two tubular boilers—length, 12 feet 2 inches; breadth, 11 feet 5 inches; depth, 11 feet 9 inches: cubic feet in steam-chests, 400: three furnaces in each boiler—length, 8 feet; breadth, 3 feet: 380 tubes, or 190 in each boiler—diameter, $3\frac{3}{8}$ inches, and 8 feet long; chimney diameter, 5 feet, and 32 feet long. Contents of coal-bunkers in tons, 75; space occupied by the coal-bunkers, fore and aft, 9 feet. Frames of vessel, $3\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ inches, and 18 inches apart. Ten strakes of plates from keel to gunwale, tapering in thickness from $\frac{11}{16}$ to $\frac{7}{16}$ of an inch. Three bulk-heads. Reverse bars on every second frame, $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8}$ inches. Deck-beams every second frame, bulb-iron, $6 \times \frac{1}{2}$ inches, with two angle-iron bars on ditto, on each side, $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{3}{8}$ inches; deck-stringers, plate-iron, $20 \times \frac{7}{16}$ inches; 'tween-deck beams, angle-iron, $6 \times 3 \times \frac{1}{2}$ inches, on every fourth frame; stringers, $15 \times \frac{7}{16}$ inches; deck-supports, of round bar-iron, $1\frac{3}{4}$ inches. These engines are the first made by this firm on the oscillating principle, and have given satisfaction. Load on safety-valve, 15 lbs.; the engines averaging 27 revolutions per minute. Speed of vessel with cargo, $10\frac{1}{2}$ knots an hour; average loaded draft of water, forward, 9 feet 6 inches, and 11 feet aft; will carry 350 tons of measurement goods; has a donkey-engine. The hurricane-deck, between the paddle-boxes, is 21 feet 9 inches in length, and 7 feet in height; is provided with a mechanical telegraph, communicating with the engine-room. Has Guerin's patent steering-gear for the rudder. Carries four boats. The cabins are very handsomely decorated, and are very commodious, and well adapted for the comfort of passengers, &c. The saloon is 54 feet long, in which are eight mahogany tables, four on each side, fitted with slides fore and aft; and the sofa-seats are covered with crimson plush velvet, extending along each side of the saloon and across the stern, being divided in lengths of six feet each by means of arms, making so many separate sofas, and can dine 92 persons at one time. The walls of the saloon are of Spanish mahogany, French polished, with gilt mouldings, &c.; the roof, of white and gold. At the entrance there is a beautiful mahogany side-board, surmounted by a marble top, above which there are two large mirrors, with finely carved and gilt frames: at the stern there are two mirrors of the same pattern. The fireplace is stone, of neat workmanship. Above the saloon there are two skylights, on the roof of which are painted flowers, fruits, &c. Suspended to the ceiling are four neat lamps, and two smaller ones at the after end. Underneath the saloon are the state-rooms, and also the ladies' cabin, all suitably fitted up and well ventilated, &c. In all, has accommodation for 88 first-class passengers. The fore cabins are divided into two separate apartments, each accommodating 14 second-class passengers, being 28 in all, or a total of 116 persons; they are painted to represent oak. The forecastle has berths for 12 of the crew. The bulwarks are of iron. This vessel was built as a consort to the *Bergen*, plying between Bergen and Hamburgh, calling at Stavanger, Egersund, Flekeifiord, Mandal, and Christiansand, going and returning during summer; after which, as long as the navigation is open, plies direct from Bergen to Crookhaven, 360 miles, and to Hamburgh, 40 miles. She was launched on the 25th of August. Draft of water at launch—forward, 4 feet 6 inches, and 5 feet 6 inches aft, being a mean of 5 feet.

DESCRIPTION.

A dragon figure-head; imitation galleries; square-sterned and clinch-built vessel; clipper-bow; two decks, with poop and forecastle-deck; standing bowsprit; two (pole) masts; fore and aft rigged.

Port of Bergen, Norway. Commander, Mr. Jacob Rick Ege.

LIVERPOOL AND OPORTO LINE OF SCREW-STEAM VESSELS: THE "MINHO."

Built and fitted by Messrs. Blackwood and Gordon, iron shipbuilders and engineers, Paisley, 1854.

Dimensions.	ft.	tenths.
Length on deck	175	8
Breadth at two-fifths of midship depth	22	0
Depth of hold amidships	13	5
Length of poop	31	2
Breadth of ditto	17	6
Depth of ditto	6	5
Length of engine-room	42	1
Ditto of shaft-space	34	5
Breadth of ditto	5	9
Depth of ditto	5	0
Tonnage.	Tons.	
Hull	$361\frac{32}{100}$	
Poop	$38\frac{62}{100}$	
Total...	$399\frac{94}{100}$	
Engine-room ... $135\frac{32}{100}$; Shaft-tunnel ... $11\frac{01}{100}$	$146\frac{33}{100}$	
Register	$253\frac{61}{100}$	

Fitted with a pair of steeple engines (on Mr. David Napier's patent 4-piston-rod principle), of 90-horse nominal power; diameter of cylinders, 38 inches, and 2 feet 6 inches length of stroke. Screw-propeller—diameter, 9 feet; pitch, 12 feet: has three blades. One tubular boiler—length, 11 feet 10 inches; breadth, 13 feet 1 inch; depth, 11 feet 10 inches. Three furnaces: 262 tubes—diameter, $3\frac{1}{4}$ inches, and 7 feet long. Carries 120 tons of coals in the bunkers. Frames, $3\frac{1}{2} \times 3 \times \frac{3}{8}$ inches, and 18 inches apart. Thirteen strakes of plates from keel to gunwale, tapering from $\frac{9}{16}$ to $\frac{7}{16}$ of an inch in thickness. Has five bulk-heads; with poop accommodation for 20 passengers. Classed A 1. Launched February 15th.

DESCRIPTION.

A bust female figure-head; no galleries; square-sterned and clincher-built vessel; clipper-bow; stationary bowsprit; three masts; schooner-rigged.

Port of Liverpool; tonnage, 417 tons O.M.

THE DUBLIN AND GLASGOW SCREW STEAM NAVIGATION COMPANY'S NEW IRON STEAM-VESSEL "IRISHMAN."

Built and fitted by Messrs. Blackwood and Gordon, engineers and iron shipbuilders, Paisley, 1854.

Dimensions.	ft.	tenths.
Length on deck	153	1
Breadth at two-fifths of the midship depth	20	5
Depth of hold at midship depth ...	12	5
Length of engine-room	28	6
Ditto of shaft-space	27	0
Breadth of ditto	3	4
Depth of ditto	4	8
Tonnage.	Tons.	
Hull	$270\frac{67}{100}$	
Engine-room ... $79\frac{30}{100}$; Shaft-space ... $4\frac{26}{100}$	$83\frac{57}{100}$	
Register	$186\frac{59}{100}$	

Fitted with a pair of steeple engines (on Mr. David Napier's patent 4-piston-rod principle), of 60-horse nominal power; diameter of cylinders, 30 inches; length of stroke, 2 feet 6 inches. Screw-propeller—diameter, 8 feet 6 inches; pitch, 8 feet $10\frac{1}{2}$ inches; two blades. One tubular boiler—length, 11 feet $2\frac{1}{4}$ inches; breadth, 10 feet 6 inches; depth, 10 feet 8 inches. Three furnaces: 188 tubes—diameter, $3\frac{1}{8}$ inches; length, 6 feet 6 inches. Contents of coal-bunker, 40 tons; consumes 7 cwt. per hour. Date of trial, July; average revolutions per minute, 45. Frames, $3\frac{1}{2} \times 3 \times \frac{3}{8}$ inches, and 18 inches apart; 11 strakes of plates, tapering in thickness from $\frac{1}{2}$ to $\frac{3}{8}$ inch. Five bulk-heads. Keel, 6×2 inches; stern-post, 6×3 inches; floor-plates, $16 \times \frac{3}{8}$ inches, turned up the bilge; reverse bars on frames, $3 \times 2\frac{1}{2} \times \frac{5}{16}$ inches. Three keelsons, $3 \times 3 \times \frac{3}{8}$ inches angle-iron, and $\frac{3}{8}$-inch plate; stringer-plate, $21 \times \frac{3}{8}$ inches, with $3 \times 3 \times \frac{3}{8}$ inches angle-iron. Deck-beams, bulb-iron, $6 \times \frac{3}{8}$ inches; 'tween deck-beams, $5 \times 3 \times \frac{1}{2}$ inches; bulk-heads, $\frac{5}{16}$ inch thick. Has a deck-house amidships, having accommodation for 20 first-class passengers, built to the sides of vessel, with a passage on each side, and is very neat and commodiously fitted up. 315 tons O. M.; will carry 280 tons of cargo. Launched from the building-yard, Cartvale, May 30th.

DESCRIPTION.

A bust man figure-head; square-sterned and clinch-built vessel; clipper-bow; no galleries; one and 'tween decks; standing bowsprit; three masts; schooner-rigged.

Port of Glasgow. Commander, Mr. Robert Paton, late of the *Northman*.

THE NEW IRON PADDLE-WHEEL STEAM-TRANSPORT "TONNING."

(The property of the North of Europe Steam Navigation Company.)

Built and fitted by Messrs. Thomas Wingate and Co., engineers and iron shipbuilders, White Inch, Glasgow, 1853.

Builders' measurement.	ft.	inches.
Length from figure-head to taffrail	240	0
Ditto, keel and fore-rake	230	0
Breadth of beam	28	4
Ditto, including paddle-cases ...	45	$7\frac{1}{2}$
Tonnage.	Tons.	
Hull	$913\frac{76}{94}$	
Engine-room	$190\frac{47}{94}$	
Register	$722\frac{29}{94}$	
Customs' measurement.	ft.	tenths.
Length on deck	229	7
Breadth at two-fifths of midship depth	27	5
Depth of hold amidships	19	3
Length of engine-room	44	5
Tonnage.	Tons.	
Hull...	$957\frac{15}{100}$	
Contents of engine-room	$256\frac{18}{100}$	
Register	$700\frac{17}{100}$	

Fitted with a pair of steeple engines (on the

4-piston-rod patent principle of Mr. David Napier), of 204-horse nominal power; diameter of cylinder, 54 inches; length of stroke, 4 feet 6 inches. Paddle-wheels (Morgan's patent feathering principle)—diameter, 20 feet 6 inches: 10 paddle-boards, length, 7 feet; breadth, 3 feet 5 inches. Two tubular boilers—length at roof, 13 feet; ditto at furnaces, 12 feet $3\frac{1}{2}$ inches; breadth, 11 feet 6 inches; depth, 11 feet. Height of steam-chests, 7 feet 6 inches. Six furnaces, three in each boiler—length, 9 feet 6 inches; breadth, 3 feet: 420 tubes, or 210 in each boiler—diameter internal, 4 inches. Coal-bunker—length fore and aft, 6 feet; and contents of ditto, 80 tons. Frames, $4 \times 3 \times \frac{7}{16}$ inches, and 18 inches apart. Spar deck-beams, angle-iron, $4 \times 3 \times \frac{7}{16}$ inches, and 3 feet apart; main deck-beams, $3 \times 3 \times \frac{1}{2}$ inches, and 3 feet apart; stern-post, 6×3 inches. Built for the Tonning and Lowestoft cattle-trade, &c. This is the 19th paddle-wheel steam-vessel built by this firm, and the 15th launched by them in their present yard, and the largest paddle-wheel steam-vessel launched in White Inch. Launched July 22nd.

DESCRIPTION.

A demi-bust female head; elliptical-sterned and clinch-built vessel; stationary bowsprit; three (pole) masts; fore and aft rigged; three decks (flush); clipper-bow.

Port of London.

STEAMER "JOSEPH WHITNEY."

Built by John Englis, New York; engines by Neptune Iron Works, New York.

Length on deck	200 ft.
Breadth of beam	33 ft.
Depths of hold	9 ft. & 16 ft. 6 in.
Length of engine and boiler space	68 ft.
Tonnage	1,000

Kind of engine, vertical beam. Kind of boiler, return-flued. Diameter of cylinder, 52 inches; length of stroke, 11 feet; diameter of wheel over boards, 29 feet; length of boards, 7 feet 6 inches; depth of boards, 1 foot 6 inches; number of blades, 26; number of boilers, 1; length of boiler, 26 feet; breadth of boiler, 14 feet 9 inches; height of boiler, exclusive of steam-chests, 10 feet 2 inches; number of furnaces, 4; breadth of furnaces, 3 feet 4 inches; length of fire-bars, 7 feet 3 inches; number of flues, 8; internal diameter of ditto, $18\frac{1}{2}$ inches; diameter of chimney, 55 inches; height of chimney, 35 feet; load on safety-valve, 25 lbs.; draft forward, 11 feet; draft aft, 11 feet; maximum revolutions, 18. Masts and rig, brigantine. Intended service, Baltimore to Boston. Frame strapped with iron. Floor-timbers, moulded, 14 inches; sided, 14 inches; and 24 inches apart at centres. Fuel, bituminous coal.

STEAM-BOAT "COMMONWEALTH."

Built by Laurence and Foulkes, New York; engines by Morgan Iron Works, New York.

Length on deck	316 ft.
Breadth of beam	42 ft.
Depth of hold at ditto	13 ft. 3 in.
Hull	1,600 tons.

Kind of engine, vertical beam. Kind of boilers, return-flued. Diameter of cylinder, 76 inches; length of stroke, 12 feet; diameter of paddle-wheel over boards, 38 feet; length of boards, 10 feet 6 inches; depth of boards, 32 inches; number of boards, 28; number of boilers, 2; length of boilers, 38 feet: breadth of boilers, front, 13 feet 6 inches; round shell, 11 feet: height of boilers, exclusive of steam-chests, 12 feet 6 inches; number of furnaces, 3 in each boiler; breadth of furnaces, 4 feet 2 inches; length of fire-bars, 8 feet; number of upper flues, 6; internal diameter of upper flues, 18 inches; diameter of chimneys, 56 inches; height of chimneys, 40 feet; load on safety-valve in pounds per square inch, 40; contents of bunkers in tons, 30; draft forward, loaded, 7 feet 10 inches; draft aft, loaded, 8 feet 2 inches; maximum revolutions, $18\frac{1}{2}$; fire and flue surface, 5,000 square feet. Masts, none. Intended service, New York to Newark.

REMARKS.

This steamer is built for service upon Long Island Sound. Her saloon cabin is upon her spar-deck, over which is a light deck, running within 50 feet of her stern, on which are double lines of state-rooms upon each side, with a large promenade cabin in the centre.

Floor-timbers, $19\frac{1}{2}$ inches moulded, $6\frac{1}{2}$ inches sided, and 24 inches apart at centres. Frame strapped with iron, diagonal and double-laid, 4 by $\frac{5}{8}$ inches.

PARTICULARS OF THE STEAM-BOAT "POTOMSKA."

Hull built by Capes and Allison, Hokoben. Machinery by Hogg and Delamater, New York. Intended service, New York and New Bedford.

HULL—

Length on deck, from fore part of stem to after part of stern-post	140 ft.
Breadth of beam at midship section	26 ft.
Depth of hold	8 ft. 6 in.
Draft of water at load-line ...	9 ft.
" " below pressure and revolutions ...	10 ft.

Masts and rig—three-masted schooner.

Engine—vertical direct. Diameter of cylinder, 34 inches; length of stroke, 2 feet 6 inches; maximum pressure of steam in pounds, 35; maximum revolutions per minute, 54; weight of engines, 20 tons. Boiler — one — vertical — tubular. Breadth of boiler, 6 feet 9 inches diameter; height of boiler, $7\frac{1}{2}$ diameter, $19\frac{1}{2}$ feet high. Horizontal tubes, five outside of tubes. Weight of boiler without water, $8\frac{1}{4}$ tons. Number of furnaces, one; number of flues or tubes, 587; internal diameter of flues or tubes, 2 inches; length of flues or tubes, 4 feet; heating surface, 1,500 square feet; diameter of smoke-pipes, 2 feet 8 inches; height of smoke-pipes, 20 feet. Description of coal, anthracite; consumption of coal per hour, one-third of a ton. Propeller — diameter of screw, 9 feet; pitch of screw, 21 feet; number of blades, 4.

Remarks.—Floors filled in solid under engine.

C. H. H.

LIST OF PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 26th August, 1854.

1875. R. A. Brooman, 166, Fleet-street—Motive power. (A communication.)

Dated 6th October, 1854.

2149. A. Smith, Princes-street—Safety-cage for miners.

Dated 10th October, 1854.

2236. S. Mason and W. Beoby, Northampton—Boots and shoes.

Dated 4th November, 1854.

2339. W. J. Wright, Redcross-street, Cripplegate — Application of tobacco-stalk.

Dated 7th November, 1854.

2355. F. Baxter, Sneinton—Compound shell.

Dated 9th November, 1854.

2377. J. Porro, 4, South-street, Finsbury—Reflection of light.

Dated 21st November, 1854.

2455. N. Callan, Maynooth college—Galvanic batteries.

Dated 23rd November, 1854.

2473. C. Crickmay, Lozells, Handsworth—Repeating fire-arms.

Dated 24th November, 1854.

2482. T. Culpin, 5, Devonshire-terrace, Blackheath-road—Waste-water preventer.

Dated 25th November, 1854.

2491. R. Roberts, Manchester—Preparing cotton to be spun.
2492. T. Greenshields, Derby—Treating cotton waste.
2494. W. Blundell, 29, New Broad-street—Surgical apparatus for benumbing sense of feeling.

Dated 27th November, 1854.

2496. J. Gillott, jun., and H. Gillott, Birmingham—Pens.
2498. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Wrought-iron wheels. (A communication.)
2500. C. Levey, Red Lion-street, Holborn—Weaving bags.

Dated 28th November, 1854.

2502. J. Clarke, Leicester—Looped fabrics.
2503. T. Restell, Strand—Umbrellas, parasols, and cases or covers, and walking-sticks.
2504. T. Staunton, Bath—Motive power. (A communication.)
2505. A. V. Newton, 66, Chancery-lane—Furnaces. (A communication.)

Dated 29th November, 1854.

2506. C. Peterson, Chall, Isle of Wight—Material for textile fabrics and papermaking.
2507. J. Taverner, Paris—Edible compound.
2508. T. and S. Knight, Southwark—Apparatus for heating water.
2509. J. Abraham, Great Crosby, near Liverpool—Draining.
2510. G. Gowland, Liverpool—Mariner's compass.
2511. J. Kealy, Oxford-street—Machinery for cutting roots.
2512. S. Smith, Nottingham—Pressure gauges.

Dated 30th November, 1854.

2514. Sir J. C. Anderson, Bart., Fermoy — Economical railway.
2515. E. Welch, 50, George-street, Portman-square—Fire-places.
2517. J. B. A. Quiquandon, Ambert, France—Corks.
2518. E. Pettitt, Manchester—Machinery for drawing cotton.
2520. W. Tayler, Howwood-by-Paisley—Furnaces.
2521. J. Sands, 11, Austinfriars—Mariner's compass. (A communication.)
2522. C. Murray, Havill-street, Camberwell — Ordnance barrels of fire-arms, &c.
2523. F. Le Mesurier, Guernsey—Cartridges.
2524. E. and J. Rowland, Manchester—Pistons.

Dated 1st December, 1854.

2526. E. Briggs and W. Souter, Rochdale—Gassing yarn.
2527. J. Arrowsmith, Bilston—Construction of forts, floating batteries, &c.
2528. J. Bernard, Club-chambers, Regent-street—Manufacture of boots and shoes by machinery.
2529. T. Wilson, 3, Moscow-road, Bayswater—Preventing the noise in omnibuses, &c.
2530. T. Restell, Strand—Guns.
2531. W. J. Cantelo, 4, Leicester-square—Barrels of ordnance and small arms and projectiles
2532. T. Littleton, Saltash—Sewage manure.
2533. C. Iles, Birmingham—Metal bedsteads.

Dated 2nd December, 1854.

2534. R. C. Witty, 9, Torriano-avenue, Camden-road-villas—Artificial light.
2535. R. Hess, Holloway-road—Voltaic battery.
2536. D. Bazaine, Paris—Common road railway.
2537. L. Gantert, Glasgow—Dyeing and bleaching yarns.
2538. J. Bilden, Gosport—Prevention of smoke.
2539. A. E. L. Bellford, 16, Castle-street, Holborn—Combustible gas.
2540. A. E. L. Bellford, 16, Castle-street, Holborn—Paper and pasteboard. (A communication.)
2541. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Palm-leaf hats and carcases for hats. (A communication.)
2542. J. Maudslay, Westminster-road—Ordnance.
2543. E. Dowling, Little Queen-street—Weighing-machines.
2544. H. Strong, Ramsgate—Prevention of smoke.
2545. J. Lister, Ruthven—Dyeing materials.

Dated 4th December, 1854.

2546. R. Shaw, Portlaw, Waterford—Looms.
2547. W. Thomason, W. J. M. Rankine, and J. Thomson, Glasgow—Electrical conductors.
2549. F. W. Russell, 19, Westbourne-street, Hyde-park-gardens—Looms.
2550. E. H. Bentall, Heybridge—Locomotives.
2551. J. Porritt, Stubbin-vale-mill, near Ramsbottom—Carding-machines.
2552. D. Collet, Paris—Transmitting power.

Dated 5th December, 1854.

2553. T. Cooper, Isle of Wight—Pipes.
2554. T. Aimgill, Busby, near Glasgow—Water-meter.
2555. C. F. Varley, 1 Charles-street, Somers-town—Dynamic electricity.
2556. J. H. Johnson, 47, Lincoln's-inn-fields—Electric telegraphs. (A communication.)
2557. G. F. Wilson and J. C. Craddock, Belmont, Vauxhall—Candles and night-lights.

Dated 6th December, 1854.

2558. Lieut. A. T. J. Bullock, R.N., Woolwich—Life-raft.
2559. J. Warhurst, Hollingworth—Furnaces.
2560. C. Costard and G. P. Collas, Jersey—Projectiles.
2561. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Coating and colouring metals and alloys of metals. (A communication.)
2562. J. Hedge, 4, Wellington-street South, Strand—Stopping bottles. (A communication.)
2563. J. W. Mackie, Edinburgh—Food.
2564. A. Martin, Westminster—Indigo. (A communication.)
2565. J. Anderson, Dumbarton—Angle and bar iron for ship-building.
2566. E. De Morny, 4, Cork-street, Burlington-gardens—Guns and projectiles.

Dated 7th December, 1854.

2567. C. Hodgson and J. W. Stead, Salford—Washing machinery.
2568. J. Phelps, Croydon—Damping labels.

2569. G. H. Eden, Birmingham—Sharpening razors.
2570. J. Fairrie, Church-lane, Whitechapel—Preparing solutions of sugar for filtration.
2571. J. E. McConnell, Wolverton—Steam-engines.
2572. F. C. Blumenthal and M. L. J. Chollet, Paris—Preserving meats.
2573. J. C. Browne, Weston-super-Mare—Wrapper.
2574. R. A. Brooman, 166, Fleet-street—Spinning-frames. (A communication.)
2575. N. B. Carney, New York—Circular power-loom.
2576. S. Heseltine, Harwich—Cannon, shot, and shell.
2577. T. Metcalfe, High-street, Camden-town—Bath chair.

Dated 8th December, 1854.

2578. E. P. Castelot, Lierre—Decolorising juices of beetroot, sugar-cane, and raw sugar.
2579. G. Aubury, Queen-street, Edgware-road, and W. R. Bridges, Gravel-lane—Portable gas apparatus.
2580. F. Jolly, Turton—Mangling machinery for piece-goods.
2581. J. E. McConnell, Wolverton—Ordnance.
2582. W. Hawthorn, Newcastle-upon-Tyne—Safety-valves.
2583. T. Brown and P. Mac Gregor, Manchester—Machinery for piled fabrics.
2584. E. Acres, Pouldren-mills, Waterford—Drying grain.

Dated 9th December, 1854.

2585. J. Thom, Birk-acre, near Chorley—Singeing fabrics.
2586. T. C. Hinde, Birmingham—Ordnance.
2587. J. Cortland, 70, Wellesley-street, Stepney-east—Safety of life at sea or in rivers.
2588. J. Higgins and T. S. Whitworth, Salford—Bayonets.
2589. G. Hale, Tavistock-street, Covent-garden — Motive power.
2590. G. A. Buchholz, Hammersmith—Threshing machinery.
2591. Lieut. R. J. Morrison, R.N., Old Brompton—Propelling ships.
2592. R. Button, Hackney—Locks and keys.
2593. E. Maniere, Bedford-row—Lamps. (A communication.)
2594. N. Johnston, Bordeaux—Buildings for leeches. (A communication.)
2595. J. A. Nicholson, 10, Chapel-place, Bermondsey—Table-forks.
2596. G. Taylor, Liverpool—Steam-engine governors. (A communication.)
2597. W. Davis, Old Kent-road—Furnaces.
2598. J. I. King and T. Brindley, 2, Leonard-square, Finsbury—Cigar and card cases.

Dated 11th December, 1854.

2599. F. Jacquot, Bruxelles—Lining of hats, &c.
2000. W. James, Crosby-hall-chambers—Spikes, bolts, &c.
2601. C. T. Guthric, New Bond-street—T and set squares, &c.
2602. W. J. Harvey, Exeter—Revolving fire-arms.
2003. N. E. Stevens, Tunbridge Wells—Joining blocks of stone.
2604. W. G. Craig, Gorton—Railway axle boxes.
2605. J. Dodds, Sheffield—Slide-valves.
2606. E. T. Bellhouse and R. Thomas, Manchester—Cranes.
2607. W. Bemrose, jun., and H. H. Bemrose, Derby—Perforating paper.
2608. F. Puls, Whitechapel-road—Electro-galvanic apparatus.
2609. A. V. Newton, 66, Chancery-lane—Conducting wire for electric telegraphs. (A communication.)
2610. C. H. R. Ebert and L. J. Levisohn, Old-street, St. Luke's—Rendering cases extensible.

Dated 12th December, 1854.

2612. G. H. Bachhoffner, Upper Montague-street—Fireplaces for consumption of smoke.
2613. T. White, Landport—Portable houses.
2614. W. Chippindale and L. R. Sedgwick, Bedale—Steam-boilers.

Dated 13th December, 1854.

2615. Jos. Mayer, Longport, and J. D. Kind, Birmingham—Door knobs and spindles.
2616. C. F. Stansbury, 17, Cornhill—Machine for cutting keys. (A communication.)
2618. A. E. L. Bellford, 16, Castle-street, Holborn—Sewing-machines. (A communication.)
2619. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Inkstand. (A communication.)
2620. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Photography. (A communication.)
2621. J. L. Jullion, Tovil—Separating fibres.
2622. Lieut.-Col. W. Grant, Bath—Prevention of smoke in domestic fireplaces.
2623. H. Berdan, New York—Compressible life-boat.
2624. S. Fisher, Birmingham—Ordnance.
2025. C. J. Taylor, Handsworth—Underground telegraph wires.
2026. T. F. Evans, Philpot-lane—Candles. (A communication.)
2627. T. Haines, Melbourne, near Derby—Warp machinery.
2628. W. C. Taylor, Greenwich—Bearing parts of shafts and axles.
2629. J. Court, jun., Sheerness—Rockets.

Dated 14th December, 1854.

2030. J. Redgate, Sneinton; J. Thornton, Nottingham, and E. Ellis, Sneinton—Lace machinery.
2631. R. Ruston, Birmingham—Anchors.
2032. L. W. Evans and J. McBryde, St. Helen's—Sulphuric acid.
2633. F. W. Padwick, Hayling Island, Hants—Projectiles.
2635. W. C. Scott, Warner-road Camberwell—Paddle-wheels.
2636. P. E. Henderson, 4, Trafalgar-square—Ventilating ships.
2637. L. Cornides, 4, Trafalgar-square—Covering glass with collodion.
2638. J. Rose, Ashford—Fire-boxes of steam-boilers.

Dated 15th December, 1854.

2639. J. Rowley, Camberwell—Embossing woven or felted fibrous materials.
2640. W. Clark, Islington—Anchors.
2641. U. Scott, Duke-street, Adelphi—Metallic bodies.
2642. A. Lyon, Windmill-street, Finsbury — Mincing-machines.
2643. L. Turner, Leicester—Weaving elastic fabrics.
2644. F. Archer, Bishopsgate-street, and W. Papineau, Stratford—Distilling peaty and other matters.
2645. R. Adams, King William-street—Revolvers.
2646. E. Strong, Carstairs, N.B.—Removing and replacing railway wheels and axles.

Dated 16th December, 1854.

2647. D. C. Hewitt, Richmond—Pianofortes.
2648. L. J. Livsey and W. Weild, Manchester—Projectiles and ordnance.
2649. J. Sykes, Huddersfield—Piecing-machines.
2650. J. Hickman and J. Smith, Birmingham—Stop-cock.
2651. T. Forshaw, Manchester—Beetling woven fabrics.
2652. Lieut. M. C. Friend, R.N., Greenwich, and W. Browning, 111, Minories—Determining magnetic aberrations occasioned by local attraction.
2653. J. Fenton, Low-moor Iron-works—Axles, piston-rods, shafts, &c.
2654. W. Eassie, Gloucester—Retarding vehicles on railways.
2655. R. L. Chance, Birmingham—Glass.
2656. D. D. Deming, New York—Machine for cutting cloth, &c.
2657. J. Martin, Soho-square — Apparatus for cleaning windows.
2658. L. Wimmer, Vienna—Baking.

Dated 18th December, 1854.

2659. M. Morrison, Chelsea—Preserving paintings on glass.
2660. C. F. Stansbury, 17, Cornhill—Life-buoy. (A communication.)
2062. W. Hartley, Bury—Safety-valves.
2663. R. Von Seckendorff, St. Helen's—Sulphuric acid.
2664. E. Whele, Birmingham—Lamps.
2065. T. Hart, 255, George-street, Glasgow—Jacquard apparatus for weaving.
2066. L. H. F. Melseus, Brussels—Saponification.
2667. J. Cunningham, West Arthurlie — Starching textile fabrics.
2668. J. H. Johnson, 47, Lincoln's-inn-fields—Extracting tannic acid from leather. (A communication.)
2669. J. Pritchard, Portsea—Screw-propellers.

Dated 19th December, 1854.

2670. A. F. J. Favrel, Paris—Machine for beating precious metals.
2672. J. B. Falguière, Marseilles—Propelling vessels.
2673. J. Avery, 32, Essex-street, Strand—Machinery for cutting metallic bars. (A communication.)
2674. F. R. A. Glover, Bury-street, St. James's—Carriages.
2675. J. G. Briggs, Kingsland—Fuel.
2676. J. and R. Langridge, Bristol—Corsets.
2677. J. Tucker, Bristol—Ships.
2678. J. Quick, Sumner-street, Southwark—Furnaces.

Dated 20th December, 1854.

2679. W. Bittleston, sen., 26, Mary-street—Ploughs.
2680. R. B. Huygens, Holland—Ordnance and fire-arms and projectiles.
2081. J. Paul, Manchester—Paper-staining.
2082. J. Higgins, Oldham—Steam-boilers.
2684. W. Milner, Liverpool—Safes and locks.
2685. A. Cochrane, Kirkton Bleach-works—Starching textile fabrics.
2686. R. Whytoch and T. Preston, Edinburgh—Twist lace machinery to fabrics.
2687. G. T. Bousfield, Sussex-place, Loughborough-road—Splitting leather. (A communication.)
2688. R. Walker, Glasgow—Telegraphing.

Dated 21st December, 1854.

2089. T. and S. Baker, Liverpool—Lifting and lowering heavy weights.
2090. J. Venables and A. Mann, Burslem—Printing and fixing colours in earthenware and other substances.
2691. G. Bell, 21, Cannon-street West, and G. C. Grimes, Wandsworth—Lucifer-matches.
2692. W. Bertram, Woolwich—Iron ships, &c.
2093. W. Greener, Birmingham—Repeating fire-arms and cartridges.
2094. H. Render, Liverpool—Night-lights.
2696. G. J. Sculfort, Mauberge, France—Screw-plates.
2697. J. Smith, Bedford—Buckle.
2698. J. H. Johnson, 47, Lincoln's-inn-fields—Railway wheels. (A communication.)
2099. J. H. Johnson, 47, Lincoln's-inn-fields—Application of the electrotype or galvano-plastic processes. (A communication.)

Dated 22nd December, 1854.

2700. L. J. F. Margueritte, Paris—Sulphuric acid.
2701. L. J. F. Margueritte, Paris—Caustic and carbonated potash and soda.
2702. J. Hunt, Birmingham—Illumination.
2703. A. Suter, 05, Fenchurch-street—Wind-guard.
2704. R. Ashworth and S. Stott, Rochdale—Spinning machinery.
2705. F. Prince, Haverstock-hill—Nipples of fire-arms.
2700. E. Loysel, Paris—Cooking apparatus.
2707. E. Loysell, Paris—New game.
2708. J. H. Johnson, 47, Lincoln's-inn-fields—Electro-magnetic engines. (A communication.)
2709. J. Downie, Glasgow—Fire-arms.
2710. F. M. Baudouin, Paris—Isolating telegraph wires.
2711. A. E. L. Bellford, 16, Castle-street, Holborn—Breech-loading fire-arms. (A communication.)

Dated 23rd December, 1854.

2712. B. M. Giroux, Liége—Locks.
2713. J. Walker, Wolverhampton—Bricks, tiles, pipes, &c.
2714. J. F. Porter, Bessborough-street—Bricks and tiles.
2715. G. Anderson, Rotherhithe — Purifying sewers and buildings.
2716. J. McKelvey, Belfast—Spinning, &c.
2718. A. Henfrey, Turin—Railways for steep gradients, and in working same.

Dated 26th December, 1854.

2720. A. Dormoy, Seuillon, near Langres—Iron shovels.
2721. C. E. White, Fulham, and F. Robinson, Putney—Railway signals.
2722. B. Bishop and J. Dyer, Birmingham—Hinges.
2724. F. S. Thomas, Fulham, and W. E. Tilley, 6, Kirby-street, Holborn—Plating metals with tin, nickel, or alumina.

Dated 27th December, 1854.

2725. J. Dundas, Dundas castle, Linlithgow—Ordnance.
2726. J. Nash, Market Rasen—Drying malt, grain, or roots.
2727. G. Carter, 42, Lombard-street, and H. C. Symons, 52, Castle-street, Southwark—Boilers and furnaces.
2728. T. Boyle, 45, Skinner-street, Snow-hill—Reflectors for artificial light.
2729. J. L. Dunn, Glasgow—Useful products from waste sulphates and nitrates.
2730. W. E. Newton, 66, Chancery-lane — Looms. (A communication.)
2731. J. Comstock, New London, U. S.—Trip-hammers.
2732. Lord Berriedale, 17, Hill-street—Washing cloth or yarns.
2733. J. Cumming, Glasgow—Ornamental fabrics.

Dated 28th December, 1854.

2734. C. May, Great George-street—Screws.
2736. J. Cockcroft, New Accrington—Printing textile fabrics.
2740. W. Ward, Sheffield—Stoves.

Dated 30th December, 1854.

2754. C. Bissell, Birmingham—Sights for rifles.
2756. E. Mayeur, 62, Tredegar-square — Centrifugal pump. (A communication.)
2760. R. S. North, Gorton, near Manchester — Railway switches and crossings.
2762. J. H. Johnson, 47, Lincoln's-inn-fields — Motive power. (A communication.)

Dated 1st January, 1855.

2. W. W. Lewis, Hanley castle—Charcoal.
4. G. Crane and I. J. Crane, Chester— Coating for ships' bottoms.

Dated 2nd January, 1855.

6. B. Britten, Anerley—Obtaining a copy of writings, drawings or tracings in ink.
8. H. L. Dormoy, Paris — Twisting silk and other fibrous substances. (A communication.)
10. C. J. Fincken, Paris—Preserving windows, &c., from condensation and damp, and from smoke, soot, and dust.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2617. J. Nesmith, Lowell, Massachusetts—Manufacture of wire netting and wire fence by power. 13th Dec., 1854.
2634. W. C. Day, Strand—Portable camp bedstead and bedding. 14th Dec., 1854.
2683. W. Donald and W. Heginbotham, Carlisle—Looms. 20th Dec., 1854.
2764. S. S. Shipley, Stoke Newington—Fittings for dressing-cases. 30th Dec., 1854.
I. E. Frascara, 12, Alfred-place, Bedford-square—Voltaic pile, and the application of its electric fluid either to the decomposition of water, or to enable the gas to replace the steam-power actually in use. 1st Jan., 1855.

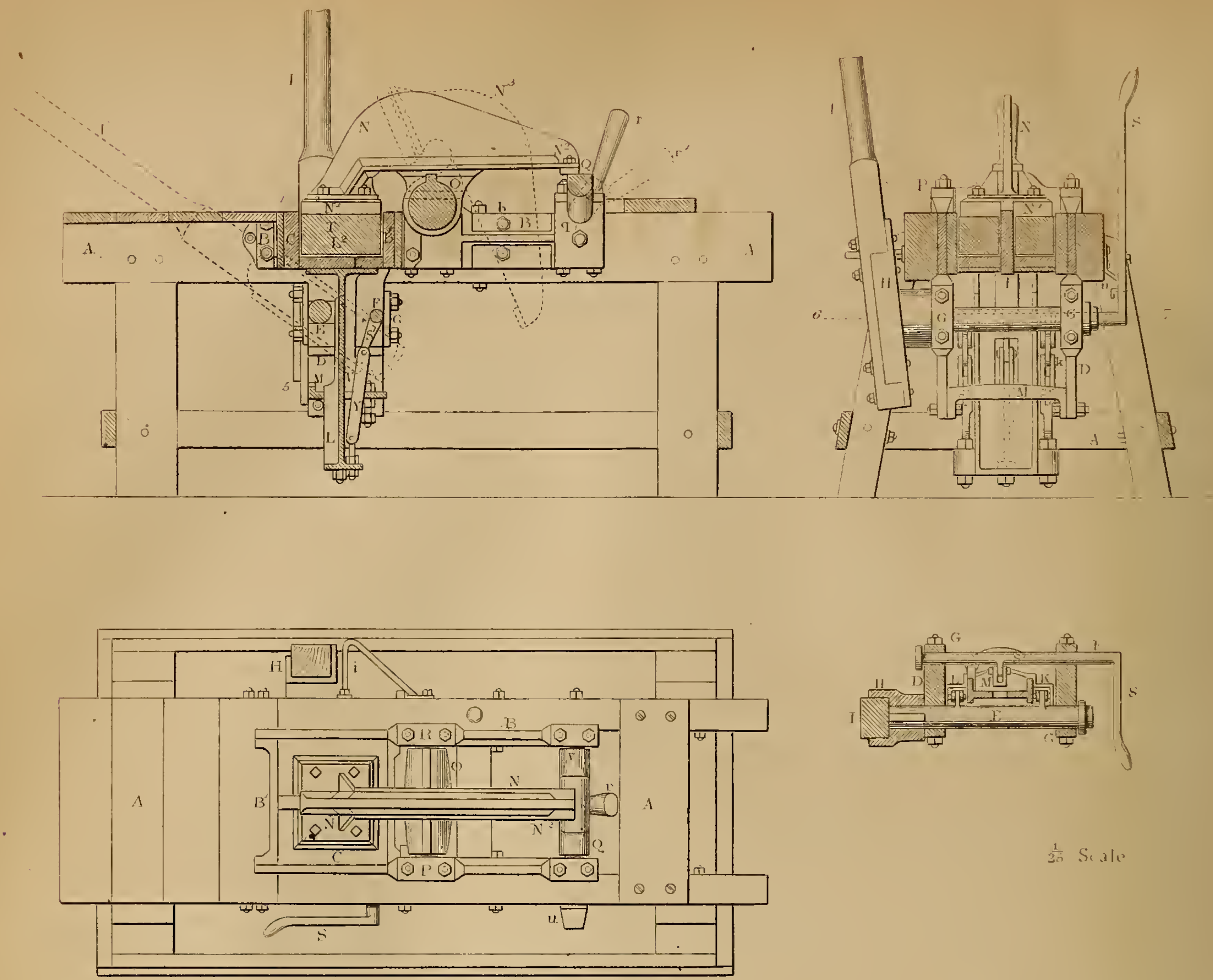
DESIGNS FOR ARTICLES OF UTILITY.

1854.
Dec. 18, 3070. William Dicks, Floore, Weedon, Northamptonshire, "Screw-jack."
" 19, 3671. Price's Patent Candle Company, Belmont, Vauxhall, "Price's Crimean army stove.
" 23, 3672. John Revell, Wellington Foundry, Newark, "Steerage horse-hoe."
" 28, 3073. William Russell, 23 and 24, Blackwellgate, Darlington, Durham, "Russell's self-ventilating air-tube coach-roof lamp.

1855.
Jan. 1, 3674. J. Westwood Astles, 64, Foregate-street, Worcester, "Empress boot-leg."
" 3, 3675. George Dowler, Birmingham, "Cigar and tobacco magazine and rack."
" 9, 3676. John Thompson, 19, Clarendon-villas, Notting-hill, "Certain parts of folding or camp bedsteads."

DRY CLAY BRICK-MAKING MACHINE.

By Julienne, Paris.

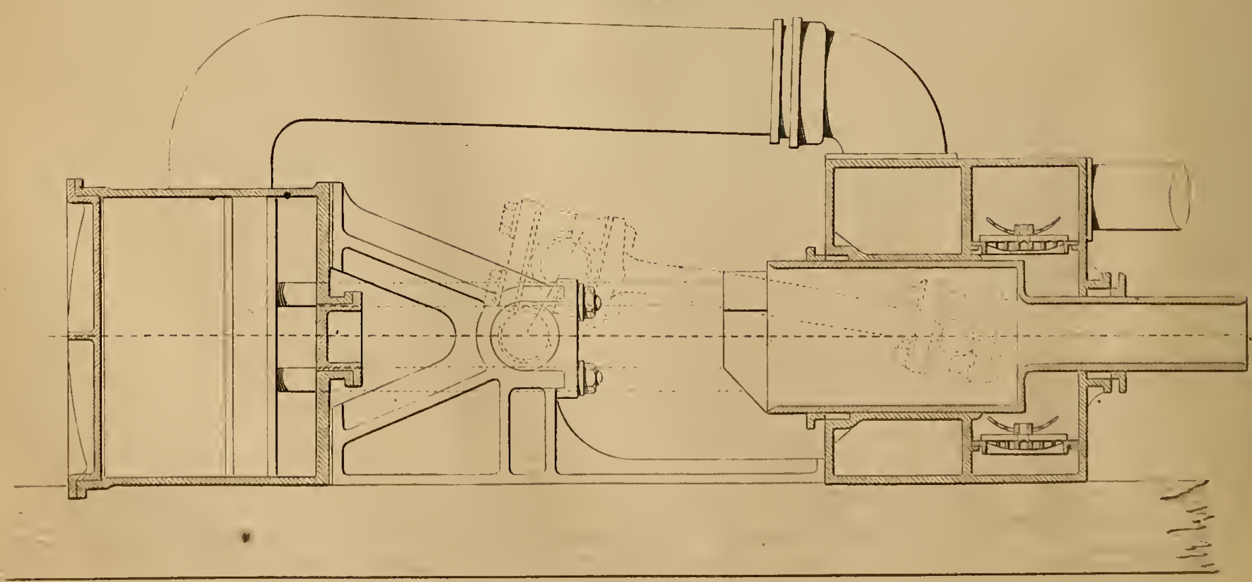


$\frac{1}{25}$ Scale

PATENT PLUNGER ENGINE.

By Beardmore & Rigby.

(10 Horses Power)



$\frac{1}{8}$ Scale

THE ARTIZAN.

No. CXLVI.—Vol. XIII.—MARCH 1st, 1855.

ENGINES OF THE SCREW STEAM-SHIP "CANDIA."

By Messrs. G. Rennie and Co.

A general description of the *Candia* was given in our number for July last, as also the particulars of her trial-trip; and, again, in "Notes on Designing Steam Machinery, No. V.," same number, a description and engraving of the air-pump will be found. In the present number the engines will be further described, as also particulars given of her steaming qualities.

Plates 30 and 31 show two elevations of the engines—an end view and a longitudinal view. The former shows the position of the engines looking aft: the piston is at half-stroke. The engines are vertical geared engines; the peculiarity of them is the hollow piston-rod or trunk, and the general arrangement.

There are two cylinders, with a condenser and air-pump to each. The headstock is supported by eight columns, keyed on bosses cast on the cylinders. The air-pumps and condensers are between the cylinders, as shown in Plate 31. The two pumps are worked by the intermediate crank. The feed and bilge pumps are together, and worked by sway-beams connected to a rod worked by an eccentric. The pump-rods are so made as to be easily disconnected from the engines: Plate 30 shows this arrangement. The main connecting-rods vibrate in the trunks, and are connected to the piston by means of a pin in the end of the rod, working in plummer-blocks fixed on the piston. This arrangement dispenses with any other guides except the cylinder itself—brings the main shaft near to the cylinders, without the disadvantage of a short connecting-rod, which in geared engines is a great desideratum—dispenses with heavy parts moving as in oscillating engines, and there are few parts combined with simplicity of workmanship.

The following are the main particulars of the engines:—

- Nominal power, 450 horses.
- Diameter of cylinders, 75 inches, equivalent to 70¾ inches diameter.
- Length of stroke, 4 feet.
- Calculated number of revolutions, 34 per minute.

The dimensions of the vessel are as follows:—

- Length, 281 feet.
- Breadth, 40 feet.
- Depth, 29 feet 6¾ inches.
- Tonnage, 2,200 tons O.M.

The trial of the *Candia* took place on May 31st, 1854, the particulars of which are given in our number for July last, where it will be seen that her speed was at 18 feet 7 inches mean draft—12·7,285 knots, or 14·65 statute miles. She made about 36 revolutions per minute. Her first trip was to Alexandria and back. On her return she was tried again, previously to her taking another trip. At 19 feet 3 inches and 18 feet 6 inches draft, she made an average speed of 12 knots; but the trial being merely to test the efficiency of the vessel, the engines only made 33 revolutions per minute, instead of 36, as in the former trial. The indicated power was 1,356 horses; the displacement of the vessel being 2,520 tons. Referring to Mr. Atherton's steam-ship *Capability*, and adopting the same formula, viz. $\frac{v^{3},\ \text{disp}^{t.\,\frac{2}{3}}}{\text{H P}}$, where $\text{H P} = \frac{p\ v}{132{,}000}$, it is found that the index number of the *Candia* is 934, being 72 higher than the *Rattler*, which is classed first in his list. If, therefore, his formula be correct, the capabilities of the *Candia* are greater than those of any other vessel.

The *Candia's* next trip was to Gibraltar, along the coast, touching at Vigo, Lisbon, Cadiz, &c.; but as her speed was not in accordance with the prescribed time, the trip was no test of her speed except for short runs. However, on Thursday, 30th August, after leaving Vigo Bay, making 35 revolutions, with fore and aft sails close-hauled, she made 13½ knots per log. On Friday, 1st September, her average speed, per distance on chart, from Cape Seliris to the Berlings, was 11·4 knots, and making 30 revolutions per minute, vacuum 27 and 27½ inches. Saturday, 2nd, she passed Port Espechel at 10h. 55m., and Cape St. Vincent 6h. 0m., being 7 hours 5 minutes, the distance being 84 miles, giving an average speed of 12 knots, very nearly.

In October the *Candia* made a first-rate trip to Alexandria and back to Southampton, and made the run from Malta to Alexandria, a distance of 820 miles, in 69 hours, with a strong head-wind against her for 20 hours, giving an average speed of 12 knots per hour. Considering that the distance run over was most likely more than 820 miles, from variations of course, the performance we believe to be the best between these two ports on record.

PRACTICAL PAPERS.—No. III.

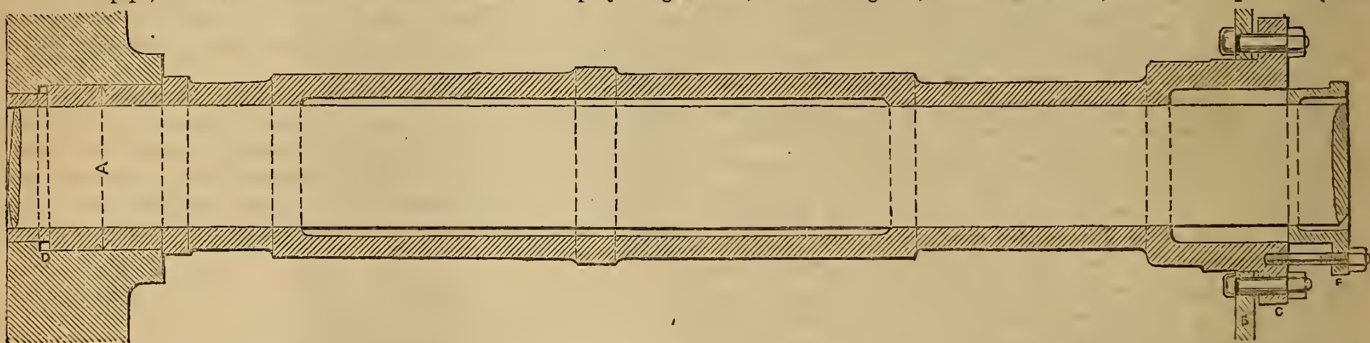
ON DESIGNING MARINE WORK.

We shall now proceed to consider the detail of "the means of transmitting the motion of the pinion to the screw"—namely, the shafts, their couplings, their bearings, and the stern-bush; and we shall commence with the stern-bush. In the majority of iron screw-steamers, it is a strong cylindrical casting, turned at one end to fit a bored recess in the stern-post (as shown in Fig. 5 in Pract. Papers, No. II., Feb.), bearing against frames, at intervals of from three to four feet, and bolted by a flange to a plate extending across two frames. The length of this "stern-pipe" or "stern-bush" is dependant upon the fineness of the run of the vessel, when, as is usually the case, the steamer is constructed much the same as a sailing-vessel, with no enlargement at the centre line of the shaft, or only just sufficient to let the stern-bush pass clear of the frames, and the pipe must be extended till the stuffing-box is placed so that the engineers can easily renew or adjust the packing in it.

If the screw were applied to a punt or rectangular vessel, evidently it would be simply necessary to prepare a stuffing-box for the prevention of leakage, as in passing a shaft through a water-tight bulkhead; and we think that the stern-pipe would be more efficiently constructed, if its use was considered merely to be a stuffing-box, and not a bearer for the screw-shaft, as well as a means of passing it through the ship's stern-post and frames.

There are two places at which leakage would ensue if means were not taken to prevent it, when the stern is constructed on the usual plan—namely, through the joint at the stern-post, and through the pipe. To prevent the first, some engineers have chased a thread on the outside of the pipe, and fitted a gland on it, to be screwed down against packing contained in a recess in the stern-post. Lately we saw a large screw-steamer fitted on this plan: it answered very well, till, unfortunately, soon after her trial-trip, the end of the pipe broke off. Others have used a gland and bolts, the packing being screwed against the end of the pipe; but the difficulty of getting to this gland prevents its general adoption.

When the pipe is required to keep water out of the ship, and also to support the screw-shaft, it is simply and effectively constructed if made as shown in Fig. 1. We should bore the stern-post through to within an inch and a half of the finished size before plating it up; the finished size of the whole being so large as to leave metal round the shaft equal to about one-fifth of its diameter. Supposing that the stern-post is 10 inches wide, as in Lloyd's table for a vessel of 1,500 tons, a boss should be formed on it, to give a sufficient bearing for the end of the pipe, and this boss should be bored say 11 inches deep to the finished size, A. The extreme end of the pipe should be reduced so as to leave an annular space into which hemp packing, or, better still, an India-rubber ring, should be placed. The pipe should be made to fit easily in the stern-post, the joint being left entirely to the hemp or India-rubber ring. To bring this ring into action, a strong flange is formed round the forward end of the pipe, and by screwing up the bolts which pass through the wrought-iron plate, B, the joint is made. To overcome the friction of the pipe, heavy bolts of $1\frac{1}{2}$ or $1\frac{3}{4}$ inches diameter must be used of proportionately strong flanges. The plate B is for steadying the end of the pipe, and is secured between two frames: the projecting part of the pipe, as shown in Fig. 1, is turned, and the plate B bored accordingly.



Thus the stern-pipe may be said to be constructed on the same principle as the ordinary cylinder cover, if we consider the frames and plate B, and the stern-post, to be in one piece, as virtually they are: the joint D is equivalent to the cylinder cover joint, the bolts in C to the cylinder cover-bolts, and the bolts at E to the gland-bolts. The only objection to this plan, if well executed, is the rapid wear: it is, in fact, an inadjustable bearing, and in order to make the best of it we have provided against some of the accidents that have often happened to steamers when the stern-pipe has not been properly adjusted.

For instance, when the stern-post has been made as shown in Fig. 5 (Paper II.), it has sometimes happened that the portion left to retain the packing has been bored, so as just to fit the shaft; by friction, caused by the parts coming in contact, in consequence of wear, the shaft has "galled" and become fixed, great trouble and expense being incurred in taking it out, in order "to make things pleasant" again. This, of course, is easily avoided by leaving one-eighth or three-sixteenths clearance here; and as the packing-ring cannot get out, the joint is equally tight. In our sketch we have shown the stern-pipe extending completely through the stern-post, which we think the preferable plan. Another mishap that has frequently occurred is, when the gland at the forward end of the pipe has been unequally screwed up, and the consequent heating and cutting of the shaft has brought the engines to a stand. In one case, we were on board a steamer, when the engines having made an excellent "start," were stopped for half an hour. When steam was turned on again, they remained motionless: blocks were connected to the shaft, and about a quarter revolution was effected; but as soon as the blocks were slacked off, the spring of the shafting returned the engines to their original position. The diameter of the shaft in the stern-bush was $5\frac{1}{4}$ inches, and, on examination, it was found that the shaft had heated and cut a series of grooves in the gland, not unlike an incipient thrust-bearing: there was no other means of getting out of the difficulty but by breaking away the gland altogether, as it was impossible to remove it by drawing it over the shaft. To guard against a like accident, these glands are constructed by the best engineers similarly to those used by Messrs. Penn in the trunnions of their oscillating engines, as shown in our sketch. Another cause of failure is observable—the heating of the shaft in the body of the pipe. We have shown it as bearing on each end for about two or three diameters in length, a clearance space being cast in the centre of the pipe, which is usually left large enough to allow water to penetrate as far as the gland. We think, if a pipe, say of $\frac{3}{4}$ inch diameter, was carried to the middle of the clearance space through the frames and plate B, and anti-friction paste or tallow forced into it by means of a tube and ram, which could easily be fixed above the gland, there would be less liability to heating. The tube might be made so as to slip into a socket at the end of the pipe, and could be charged from a bucket in which the lubricating substance had been melted and filled up to the proper depth. The necessary quantity to force in might be ascertained when the ship was in the graving-dock.

In addition to carefully boring the stern-pipe and turning the screw-shaft, we should grind, or rather "scour," off the inequalities (which are often found in lathe-work, however carefully executed) on their surfaces. The stern-pipe would be placed on the shaft, and the latter would be fixed between the lathe centres: by putting on a quick speed, previously having introduced oil and emery into the body of the pipe, and moving it horizontally over the shaft, we should effect the desired end; and we think an hour's work devoted to this operation would save many days' labour afterwards.

When there is much inclination in the shafting, it is usual to interpose between the flange C and the plate B another plate, wedge-shaped in section, with one side parallel to the flange C: by this means the boring of the holes for the pipe and the screwing-up bolts is facilitated. When the frames are at right angles with the shaft, there will, of course, be no necessity for this additional plate, as the face of B will then be parallel with the flange C.

We have now indicated how, with the present mode of constructing the after part of an iron screw-steamer, a very "good job" can be made of the stern-bush or pipe; and, to assist it, we should always fix outside bearings on the stern-post and rudder-post also: brass and brass must be the rule with regard to these bearings. Wrought-iron and cast-iron gall and fiercely attack each other under water, though they agree to admiration when brought together under a locomotive boiler, as eccentric and eccentric strap: iron, brass, and water form a voltaic circle of the first order; and brass stern-bushes, which were used some years ago in iron ships, have been so universally condemned, that we did not think it necessary to specify the material that ought to be used. Wrought-iron has been used, as a casing, white metal being run into it, round the shaft. The practice of running metal, commonly called "patent metal," into bearings, finds much favour with some engineers; but it unfortunately often runs out again when it is most wanted, which, we think, disqualifies it as a substitute for well-adjusted "brasses" in important bearings.

We understand that one of our most eminent Thames engineers has, with complete success, adopted the following method of fitting the stern-bush:—The outer end is bored up so much larger than the screw-shaft as may be required to allow a set of lengths of lignum-vitæ to be introduced, arranged like the staves of a cask, or as some of the American engineers line their air-pumps, by placing narrow pieces of brass round the pump, keying all up tight with the last length, which must be *driven* in. This hard-wood bearing is said to be superior, in every respect, to anything that has yet been tried.

In mill-work we often find what are indifferently called plummer-blocks, bearings or pedestals of apparently unnecessary strength. When some given power has to be given out at a distance, say of 60 feet, from the prime mover by the interposition of gearing, we find the bearings of uniform strength. Now, the end one taking the lateral stress of the wheels directly, ought to be the strongest; but in practice we should want too many patterns to suit the various degrees of strength required. The pedestal is made strong enough for the greatest amount of work that can come on it; and we do not generally discriminate between a supporter of the shaft, and a maintainer of its position laterally and vertically. But when the screw-propeller began to be extensively applied to steamers, a new race of pedestals was begotten, which we may distinguish as *engineer's pedestals*, differing from the *millwright's pedestal* in strength of sole, sides, and bolts.

The stern-bush is one fixed point; the engine-bearings, in direct-acting, and the pinion-bearings in geared engines, the other; the intermediate shafts being generally connected with strong, well-fitted, flanged couplings, which add greatly to the stability of the *line*. Without demonstration, it must be evident that if a shaft was made 100 feet long, it would be much more liable to deflection than five lengths connected with flanged couplings; for, considering the line of shafting as a beam, by increasing the diameter of the flanges, the depth of the beam is virtually increased, *cæteris paribus*, the strength.

It has been found advantageous by many experienced constructors to make the brasses circular, in place of square, hexagon, or octagon, as the old millwrights used to form the outside. This innovation may be accounted for by calling to mind the great superiority of the tools in use at present, which enables the turned brass to be "got up" at less cost; though, when both are equally well fitted, there is no practical superiority in the one kind over the other. Further to save expense, the circular brass is often cast with alternate clearance spaces and bearing strips; the pedestal, of course, being made to correspond, the bearing strips varying in width from three-quarters to one and a half inches. It is prevented from turning with the shaft, either by a projection cast on the bottom fitting into a recess in the sole of the pedestal, or by screwed bolts passing through lugs on the flange, or by a "flat" formed on the flange, bearing against a ledge or projection cast under it on the pedestal, or over it on the pedestal cap. We do not think that very much is gained by the fitting strips: there is practical difficulty in increasing the speed of the traverse of the tool over the clearance spaces, and the permanent advantage of bearing surface ought not to be sacrificed to the temporary advantage of cheap fitting. If the brasses could be prevented from moving at all in the pedestal, it would then be unnecessary to bore and turn them throughout; but if there is ever so little "shake," there certainly is wear: it only requires time to make it appreciable. We think a very excellent plan of securing, after turning them into the pedestal, would be to drill through the crown into the cast-iron, say an inch tapping-hole, and countersink the brass, fitting bolts in number proportionate to the diameter and length of bearing: the heads should be cut sufficiently deep to prevent the slot being bored out, and having screwed the bolts up they might be finished as usual. The heads might be filed so as just to clear the shaft after the boring was completed, and the sharp edges taken off the countersink if thought advisable; and thus we should make the brass, as it were, part of the casting, without losing any advantage gained by having it a separate part of the pedestal, as composed of pedestal proper, brasses, and cap.

We do not think it necessary to quote any thumb rules as to the thickness of brasses, &c., merely remarking that clumsy hands are not always strong, recommending the *pattern-loft* and *brass-room* to the student's particular attention—localities generally neglected by those who are not directly caused to pay them many visits.

(To be continued.)

REVIEWS.

THE SANITARY CONSTRUCTION OF SCHOOLS.*

(SECOND NOTICE.)

In our first notice of this work in last number, we adverted to the amount of sickness existing amongst our youth of both sexes, during the period of what we termed their educational existence, as probably arising from, and owing its virulence and extension to, defective school arrangement and construction. So evident, indeed, is the truth of this, that the wonder is that so little attention has been paid to this department. In looking back to the period of our school life, there are few amongst us who cannot remember, and that most vividly, the discomforts of our school-rooms, and trace with ease the connexion between these and the illnesses which every now and then afflicted our neighbours or ourselves. Nevertheless, extensively as this experience must be diffused amongst the business-men of our time, it is somewhat singular that it has not resulted in some attempt at bettering the condition of their own children in so far as this same point of school construction and arrangement is concerned. We remember the evils we had to encounter, but think it, however, not worth the labour to inquire whether our children have still to battle with them. It seems difficult, indeed, to trace the cause of this indifference to the interests—we mean the health interests—of those so closely connected with them. Possibly we may find a reason for it in the consideration of the fact, that nothing is so rapidly forgotten as boyish discomforts; we may remember them, but the reminiscences are not painful ones generally: and the idea may also be lurking with us, that those hardships attendant upon a school life have, in the main, a beneficial influence—they test and perhaps inculcate habits of endurance which may be useful in after-life. Doubtless, in the formation of character, the evils here alluded to, viewed as inculcating habits of endurance, are useful; but we do not see the necessity that exists for giving the lessons at so great a risk. Physical and moral endurance, and self-control, can be taught without involving physical and moral evils; and where the latter are the result of the teaching, we may set down the plan on which the lessons are given as bad in its nature, to say the least of it, and as all-worthy of immediate amendment. To those who do not require to be convinced that defective sanitary construction certainly involves physical and moral evils, we heartily recommend Mr. Barnard's work, as abounding in practical hints on the subject of school construction; and to those who do not believe the above truth, we as heartily recommend its perusal, for it abounds also in valuable remarks on what may be termed the philosophy and the physiology of sanitation, well calculated to convince an unprejudiced reader, desirous only to arrive at a just estimate of the truth of the position we have above noted.

In a work which is so full of valuable information—little or no space being taken up in the discussion of points irrelevant to the main subject—it is difficult to decide on the points to which we should direct the reader's attention: those, however, having reference to construction will obviously be most interesting to the readers of The Artizan. Under

* "Practical Illustrations of School Architecture. By Henry Barnard, Superintendent of Common Schools in Connecticut. Second Edition. New York: C. B. Norton. London: Trübner & Co."

this head the salient points are, the arrangement of water-closets, and of warming and ventilating apparatus. In few, very few schools, at least up to a very recent period, was proper attention paid to the important department of water-closets. Our memory takes us back to one school, having a high reputation moreover for gentility—save the mark! —in which this place was positively disgusting. Habits of endurance might be inculcated there, and certainly in no place could habits of stolid endurance be more useful; and this, no doubt, was a type of what other places generally were—if, indeed, they were so high up in the scale as to have any convenience of this nature at all. The following remarks of Mr. Barnard on this point will apply equally well to British School architecture:—"No department of school architecture among us requires such immediate and careful attention as the arrangement and construction of privies. In none is there now such niggardly economy, or outrageous disregard to health, modesty and morals, practised. Over this portion of the school-premises, the most perfect neatness, seclusion, order, and propriety should be enforced; and everything calculated to defile the mind, or wound the delicacy or modesty of the most sensitive, should be immediately removed, and vulgarity in respect to it, on the part of the pupils, should receive attention in private, and be made a matter of parental advice and co-operation. *Neglect in this particular, on the part of the community, in providing suitable buildings and premises, or of the teacher, in enforcing proper regulations, has been followed with the most disastrous results to the health and happiness of thousands of pupils.*" (As suggestive of much that is valuable, we put this sentence in italics.) "There should be one provided," continues Mr. Barnard, "for each sex, widely separated from each other—indeed, from the general play-ground—and accessible by a covered walk, and, if practicable, from the basement or clothes-room appropriated to each sex, and kept locked, except during school-hours. They should be ventilated, and frequently and thoroughly cleansed. Where *water*-closets can be introduced, it will be a wise economy to adopt them."

On the subject of warming and ventilation there are many exceedingly practical—and in this way all the more valuable—remarks and rules. In the elaborate Report of the School Committee of Boston "on the subject of ventilation," there is much that is particularly worthy of notice. In discussing very fully the question of the importance of ventilation, they have the following remarks, which are too applicable to the condition of many of our schools as now existing in this country:— "The very earliest impressions received by your Committee, in their visits to the school-houses, satisfied them of their lamentable condition in regard to ventilation. In some of them they found the air so bad, that it could be perceived before reaching the school-rooms, and in the open entries; and the children, as they passed up and down the stairs, had their clothes and hair perceptibly impregnated with the fœtid poison. And these circumstances existed in houses where the open windows testified, upon our entrance, that the masters had endeavoured to improve the atmosphere by all the means placed at their disposal. To this custom—that of opening windows in school-rooms—the instructors are compelled to resort for relief, and this expedient certainly is the lesser of two very great evils. * * Yet this dangerous and injurious practice only mitigates the evils of bad air, by creating others. It produces colds and inflammatory complaints, and the air still remains impure, offensive, and highly deleterious—sufficiently so to affect the delicate organisation of childhood, to blight its elasticity, and to destroy that healthful physical action on which depends the vigour of maturer years."

Warming, although looked upon as distinct from the process of ventilating, is essentially connected with it: indeed, ventilation without warming will in winter be unsatisfactory, from the amount of cold air admitted to the building; and warming without ventilation in the same season, from the difficulty that exists in creating currents so as to diffuse well and economically the heat prepared, from whatever source obtained. Again, in summer, although warming is not desiderated, ventilation is—if that is possible, being so much wanted at all times—perhaps more so than in winter; and ventilation, without some application of warming, is not easily attained. Hence, where real efficiency is required, both warming and ventilating should be carried out in conjunction. The recommendations for practice of the Committee above alluded to are based upon this twofold application. The climate in North America renders some method of more economically producing warmth than the open fireplace imperatively necessary: hence the almost universal adoption of close stoves. These, placed at the lowest part of the building, and so arranged as to produce a large quantity of air at a low temperature rather than a small quantity at a high, seem to be the most effectual and economical contrivances for producing equally-diffused heat. In the Endicott School-house, ventilated by the Committee, the plan adopted was the following:—Two stoves were placed in the cellar; the air to supply these being taken by ventiducts from the external atmosphere. Each stove supplied one room above it with warmed air—this being taken up flues made in the wall. At the point where the warm air gained access to the interior of the room it was destined to reach, an opening was made in the outer wall directly behind the register, through which the warm air was admitted: this opening being regulated by a revolving damper, any amount of dilution of the hot air from the stove was obtained. To take away the foul air, large wooden boxes, or ventiducts, were carried from the floor of each room to the attic, where they communicated with a tin cylinder by means of metal pipes. The tin cylinder was carried above the roof, and terminated by a cowl. Openings were provided at the floor and ceiling lines of the rooms into the ventiducts, which could be used separately or together. An air-tight coal-stove was placed within the tin cylinder in the roof, by which an artificial current was produced.—We give this plan a place here, as it may afford a suggestion of some practical value. Before the alterations were carried out, the ventilating flues for withdrawing the vitiated air were small, and carried up into little separate chimneys, piercing the roof above the coping. These were found insufficient, inasmuch as, in addition to their too small size, they were affected sensibly by down-gusts, which completely reversed their action in certain states of the atmosphere. The quantity of air admitted to the stoves from the external atmosphere was also too small, and the openings were consequently enlarged. The object being to admit a large quantity of air moderately warmed, the enlargement of the flues conveying the hot air to the rooms from the stove was the next point: these, however, being built in the wall, the Committee had to make openings in the wall above noted. The great utility of the central ventilating flue, into which the various ventiducts are led, has been practically demonstrated by a large number of successful cases. Side-flues in the wall are rarely efficient: if they open into an empty space between the ceiling and the roof, the ascending current is much vitiated; if they open to the external atmosphere, gusts blow down them,—if, indeed, they are not altogether stopped up by birds building their nests in them—a result often attained. We remember once being called upon to ventilate a school-room, which process had been attempted to be performed by this plan of side-flues. As no current, either up or down, could be traced in these flues, we caused one to be examined, when it was found to be absolutely crammed with birds' nests from one end to the other. We adopted the plan of a central ventiduct with side openings for the admittance of fresh air, and found it perfectly successful. The following is a sketch of the plan as recommended for adoption by the Committee: —The furnace is placed in the cellar or lowest story of the building; the air to be warmed by this is led from the atmosphere down a flue, the opening to which, at the roof, is finished with a *cowl, the mouth towards the wind:* the air is taken from this altitude because it is generally purer than at the level of the ground—that is, freer from gross extraneous impurities. The smoke-flue of the stove is led up the opposite wall. The warm air generated by the stove is led by a vertical flue, branching out into two horizontal channels below the floor of the room to be heated. Horizontal plates are placed above the register for admitting the warm air; this impinging upon the plates, is diffused throughout the room. The warm, vitiated air is at once carried to the atmosphere by means of a central ventiduct passing through a space between the ceiling and the roof, and finished with a cowl or cap. A lamp is placed in this ventiduct to create an additional current.

The Committee, in a subsequent Report, showed the importance of this adjunct:—"This part of the arrangement is deemed especially important. In clear, cold weather, when the furnaces are in action, and a current of warm air is constantly setting into one extremity of an apartment, it is not difficult to establish and maintain an ascending exit current from the other end. The air is forced into the ventiduct by the constant pressure from the other end. Moreover, it enters the ventiduct already warmer than the external air. The ventiduct itself becomes warmed, and so, the current once established, it perpetuates itself. But when the furnaces are not in operation, nothing of this sort takes place; and yet this occurs precisely in those parts of the year when ventilation in a school-room is most needed, viz., in moderate weather, when it is not warm enough to open the doors and windows, and yet not cold enough to maintain a fire. At such times, the stove in the loft, acting directly and powerfully upon the ventiduct, will at all times create an ascending current, sucking the foul air up, as it were, from the several apartments, and thereby causing fresh air to enter from the other extremities." Not only in moderate weather is this adjunct useful: in very hot weather its aid will even be more highly appreciated. Ventilation depends essentially on the formation of currents; these currents being formed by the ascent of hot in cold air. Where the temperature of air from a room is very nearly equal to that outside the room, the current is very sluggish. Oil will rise in water, but not oil in oil, if of equal density: where oil is put into the bottom of a vessel filled with oil of only a slightly greater density, the oil put in will rise but very slowly. So, in the case of warm air from a room entering an atmosphere nearly as warm, the ascent will be very sluggish: this sluggish movement we have, with marked success, changed into a quick movement, by the use of a lamp suspended at a short distance beneath the mouth of the ventiduct.

In the warming and ventilating of a detached school, a point of some importance is the situation of the stoves, if these are used in place of hot water or steam. On this point the Committee, in their Report, gave some practical remarks. Two plans are obviously open for adoption: the placing of the stoves centrally, distributing the warm air from thence to various parts of the building; and secondly, the generating of the heat at the extremities, and the centralisation of the ventilating apparatus. As the settlement of this point involves some practical consideration of importance, we give a summary of the recorded opinion of the Committee thereupon. In the event of the adoption of the first plan, the necessity of having the ventiducts for carrying off the foul air as near as possible to the apertures for admitting the warmed air, would involve their being situated at the ends of the building, inasmuch as the warm air brought from the central stove is admitted at the ends. This is open to the following objections:—The end walls in which the foul-air ventiducts are carried up being necessarily colder than those of the centre, the ascending current is cooled, and consequently retarded. Again, if the method of having anchors to secure a current in all weathers is adopted,—namely, by a lamp or stove,—this necessitates a separate lamp or stove at each ventiduct. By adopting the plan of placing the furnaces at the ends of the building, and the foul-air ventiduct at the centre, all these disadvantages are obviated. The following are points relative to the size and position of the flues:—In the class-rooms, thirty-eight by twenty-two, the warm-air flues average one and one-sixth square feet; the foul-air ventiducts, one-third of a square foot. The warm air is admitted at the bottom of each apartment as near as possible to the level of the floor; and the ordinary opening for the escape of the foul air is also on a level with the floor at the opposite extremity, so as to sweep continually the lower stratum of air in which the pupil is immersed. This plan, it will be noticed, is in direct opposition to the plans generally adopted, in which the openings for the exit of the foul air are placed at the highest point of an apartment. Openings, however, are recommended to be placed near the ceiling into the ventiducts, to be opened when the heat becomes excessive. The temperature for school-rooms is recommended by the Committee to be from 64° to 68° Fahrenheit, this range including that of the healthiest climates in their best seasons. The size of the pipes and registers, where hot-air stoves are used, will vary according to circumstances: the following are given as a general rule:—For a *first*-floor room, 15 feet square, size of hot-air pipe, 8 inches; register for the same, 8 × 12. A room 20 feet square, 10-inch pipe; register, 9 × 14: 25 feet square, 12-inch pipe, 12 × 19 register. Where the hot air is taken up to apartments on another story, the size of the hot-air pipes should be smaller by two inches in diameter than those for the room below. Although hot-water apparatus is recommended for use in this country, as more economical and easily controlled; still there are many districts in which the use of hot-air stoves may be used with safety and satisfaction, and constructed at a cheaper rate than hot-water apparatus. To parties in such situations we recommend Mr. Barnard's work, as containing ample directions for the fitting up and the economical use of stoves.

In taking leave of this work, we again direct attention to the valuable nature of its contents. On every point of school architecture and arrangement, the reader will find some remark or remarks of high practical value. Looked upon merely as a record of practical experience of teachers and others, it affords an exceedingly satisfactory evidence of the important position which the education of the people occupies in the social economics of the Americans. Such a work, we fear, could not be brought out in this country,—the materials do not exist for it. A record of plans proposed might doubtless be got up; but of plans executed, examples do not exist in sufficient numbers to afford matter for two or three chapters of such a book as Mr. Barnard's. Nothing could, we think, more forcibly show the relative estimation in which practical education is held in the two countries, than a detailed list of the various works published in connexion with the subject. Mr. Barnard, in addition to the present, writes or edits twenty-seven books and Reports.

Report of the Commissioner of American Patents for the Year 1853.

These useful Reports display an organisation and management on the part of the American Patent Office which is truly commendable. Here is a respectable octavo volume, profusely illustrated, and giving the titles, descriptions, and claims of every patent issued for the year 1853, as well as other valuable information relating to patent matters. But it is not merely as a record for patents that we admire these Reports: they present you, as it were, with a bird's-eye view of the tracks which American industry is wont to follow. Machines for the manufacture of wrought-iron railway-chairs appear to receive a considerable share of attention; and as to cast-iron car-wheels, a whole tribe of schemes have twisted and twined them into every conceivable form, without any apparent object. Wrought-iron wheels for carriages, and those on the Mansell principle, of which little else is now used in this country, seem to be there all but unknown: but if American car-seats be anything like those illustrated in the Report before us, they present a marked contrast to the seats of English railway-carriages. Here are numbers of designs for giving the backs of the seats various degrees of inclination for reclining comfortably, besides fulfilling other conditions involved in pleasant travelling; while the position which travellers in English carriages are obliged to assume is more like the infliction of a posture-master: to sit bolt upright on a hard deal for twelve and fourteen hours is anything but pleasant; they appear to manage these things much better in America. Then, again, there are a number of designs for forging and rolling spikes by machinery—others for the manufacture and purification of resin oil; and auriferous quartz-crushers, harvesters, revolvers, breach-loading guns, elastic packings, and all the current tendencies of the day, have some ingenious votaries. Of course, there are a few examples of erratic minds which spurn ordinary pursuits, and we have, as specimens, a planetary hydraulic steam-engine; a double steam-engine for actuating the rudders of vessels; a patent gin for killing crows (their *nigger*-ly colour, we presume, has invited the malice of the inventor); and a host of others not worth the paper on which their bare title is printed.

We notice in the present Report the first attempts which have come to our knowledge of American engineers using, or proposing to use, the link-motion. R. H. Townsend, of New York, proposes to connect one end of the link to an eccentric in the usual manner; but to connect the other end to a cam, and the link, instead of acting as a reversing gear, is connected to an ordinary governor, under the supposition that the governor will actuate the slot-link, and move it from the eccentric end to the cam end, and give the slide-valve any degree of travel between that given by the eccentric and that of the cam. Now, it will be seen at once that this detail would be as clumsy as it would be expensive; and, what is more inexplicable, the inventor still retains the common throttle-valve, to be "*opened farther, by a peculiar apparatus, in case the slide-valve does not supply the required steam.*" The objects aimed at by the inventor are, therefore, no more than can be obtained by the throttle-valve and slot-link applied as has hitherto been sanctioned by experience in this country; but in the design in review, both slot-link and governor are perverted from their most useful functions: in fact, to suppose that a governor *will* control a slot-link, is simply ridiculous; the link would be far more likely to control the governor, and pull it about in any direction. We do sometimes come in contact with strange misapplications of simple things, but we have not seen or heard of anything like this since the introduction of wheelbarrows into one of our African colonies, where it was not without some difficulty a native could be pursuaded that they were *not* to be carried on the crown of his head.

The Bourdon pressure-gauge, which is such a deserved favourite with English engineers, has, we perceive, been re-invented and patented in America, under the name of the "bent-tube pressure-gauge." A plagiarism so palpable should not have escaped the attention of the Patent Office authorities.

Richard Solis, of New Brunswick, has patented what he terms the "art of re-manufacturing insoluble or vulcanised India-rubber;" the process of which is, to cut the vulcanised India-rubber into small pieces, masticate it by machinery, when it is ground to a powder, and mixed in that state with a paste made of ordinary India-rubber and spirits of turpentine — equal portions of each. The inventor says that a good fabric may be made by the mixture of equal parts of the vulcanised India-rubber with the native rubber, and then dried in the sun and air, without artificial heat. We, therefore, conclude that this re-manufacture of insoluble rubber is only for articles for general use, and not for steam-engine packings.

A steam-boiler possessing some novel features has been patented by Charles F. Sibbald, of Philadelphia. The flame is made to pass through a series of triangular spaces, presenting an extensive heating surface, and from which the bubbles of steam will not fail to rise freely; but the inventor proposes to have an extra steam-chamber at the bottom of the boiler, and surrounded, in a great measure, by the water. A little reasoning will show the fallacy of such a plan. Since the coldest portion of water (if above 40° Fahrenheit) falls to the bottom of the vessel in which it is contained, so in a steam-boiler will the feed and coldest of the water be at the bottom, and this adjoining the steam-chamber would reduce the temperature and pressure of the steam therein in proportion to the temperature which it had in the upper chamber, and the temperature of the water which surrounds it in the lower. Nothing, therefore, would be gained by such a plan; and if working at high temperatures, the loss might be considerable. A very efficient boiler, we believe, might be carried out by having triangular flues, for we have often thought of the self-same thing as a substitute for small tubes in marine boilers; but the subject requires more consideration than, we must confess, we have devoted to it, and, for the present, we content ourselves with drawing the attention of marine engineers to the idea.

There are several other inventions which we think will be interesting to our readers. As these, however, will require to be illustrated, we will reserve them until next month.

The Chemistry of Common Life. By Professor Johnston. Blackwood.

The second and concluding volume of this delightful work is now before us, and we congratulate the learned author on his success in keeping up the interest excited by the first parts. That the verdict of the public is no less favourable than our own, we meet with frequent and satisfactory evidence.

The first eight chapters of the volume are devoted to narcotics—an amount of space which may strike the reader as disproportionate, until he learns how vast, how all but universal, is the consumption of these (in our opinion) deleterious drugs, and how large the amount of capital and labour embarked in their cultivation. "The craving for such indulgence," remarks the author, "and the habit of gratifying it, are little less universal than the desire for and the practice of consuming the necessary materials of our common food." Tobacco, he estimates, is used among 800 millions of men, opium among 400, Indian hemp among from 200 to 300, betel among 100, and coca (not to be confounded with cocoa) among 10. The amount of land employed in the culture of four of these substances—tobacco, opium, hops, and coca—is nearly seven million acres; whilst their annual value where grown, leaving out all duties, retailers' profits, &c., is estimated at above sixty millions sterling; — a pretty large sum to be spent by the human race upon indulgences, in most cases decidedly pernicious, and whose benefits, to say the least, are highly problematical. The author views these practices with more toleration than we can feel. Though a desire for something physically "soothing" may be found in certain minds, we think the monkey faculty of imitation has a great part in the matter. Puppy junior sees Puppy senior smoking a cigar—thinks it "manly," and does likewise. The author is of opinion that fiscal and statutory restraints are of no value. He forgets that when the trade in narcotics is free, many individuals are led into temptation who might otherwise escape. The comparative consumption of tobacco in England and the United States proves that the fiscal restrictions in the former country are not wholly inoperative.

The action of these narcotics upon the brain gives rise to a variety of chemico-physiological considerations of the highest interest. We see that an almost infinitesimal particle of certain substances entering into the nervous system may affect man, not merely physically, but, for the time being, what is called morally. It is not too much to assert that when our acquaintance with physiological chemistry shall have become more extended, we shall be able to excite or allay, at pleasure, every passion of the human mind. Very remarkable is the effect of the *thorn-apple.* Persons under its influence see objects so magnified, that a straw lying across their path appears like a beam or tree-trunk, and they leap or scramble over it. This reminds us how the witches of the middle ages were detected by their stumbling at straws. The thorn-apple, we know, formed one ingredient of the celebrated witch ointments. At page 190, we find the following remarkable passage, as a quotation from Moreau:—"Every feeling of joy and gladness, even when the cause of it is exclusively moral—those enjoyments which are least connected with material objects—the most spiritual, the most ideal, may be nothing else but sensations purely physical developed in the interior of the system." Our metaphysical friends will assuredly, some of these days, find the last fragment of ground cut from under them, and be driven to an "Othello's occupation gone."

But what will the reader say when he learns that arsenic, that old-established respectable poison, is in Styria taken regularly as a tonic and stimulant, and that its use, in small doses, may be indulged in with as great impunity as that of tobacco! It strengthens the lungs, renders its partakers long-winded—we hope its use may never become common among town-councillors and other local boards—and, besides, imparts "plumpness to the figure, clearness and softness to the skin, and beauty and freshness to the complexion." Thus, the Styrian maidens attract their lovers by the very same drug which the good wives of Essex employ to get rid of their husbands! Discontinuance of the practice is attended with all the symptoms of incipient arsenical poison; whilst, on the other hand, a slight excess proves no less injurious.

Still more remarkable is the eating of *clay*, prevalent in Guinea, Java, the Himalaya, Finland, and South America. This habit is the more unaccountable, as, contrary to the vulgar opinion, there is not the least trace of clay (alumina) in the human frame.

The two following chapters are devoted to an interesting account of perfumes, their origin and properties. The manufacture of artificial odours from substances the most repulsive, may be termed one of the most striking trophies of modern chemical art. What would our ancestors have thought of the man who should propose to extract the "spicy breath of all the Arabies" from the drainings of a cow-house? Did alchemy ever attempt aught half so wonderful? Yet this is but a trifling instalment of what chemistry even now holds out to our view. In this section, the author calls attention to an interesting fact—that odours, like musical sounds, exhibit, according as they are combined, the phenomena of concord and discord.

From perfumes, the next chapter plunges us at once into stenches—a region more familiar than pleasant to the inmates of the laboratory. Sulphuretted hydrogen—a necessary evil, if such things exist—comes in for its share of denunciation. The unpleasant emanations of asafœtida (with the tincture of which we once persuaded a young fop, blunt in the olfactories, to anoint his locks), onions, and garlic, are traced to the presence of sulphur in the form of *allyle*. Mustard, horse-radish, cress, radishes, are all shown to owe their pungency to the same principle. But could the most refined malice wish a greater misfortune to an enemy, than to swallow a dose of tellurium? "A single grain of a compound of the metal tellurium, administered to a healthy man, will make his neighbourhood perfectly intolerable for weeks, and sometimes even for months, after he has swallowed it!" We find a suggestion as to the use of cacodyle and its compounds in war. Perhaps a copious administration of this fearful poison might be the best method of dealing with Sebastopol: nor do we conceive that any scruples need be felt about thus dealing with the common enemy of civilisation.

By way of consolation, this survey of evil odours is followed by a chapter on disinfectants and deodorisers. The barbarous custom of disguising or drowning foul emanations by scents is justly condemned. The action of charcoal in absorbing and condensing miasmata is next explained. The charcoal respirator is justly characterised as a most important invention. Coarse charcoal-powder, wrapped up in metal gauze, covers the mouth and nose, and thus filters all air before it can enter the system. To grave-diggers and sewer-cleaners, to those employed in unwholesome manufactures, to nurses and surgeons in fever-wards, to travellers and agriculturists in swampy regions, it must prove invaluable. Among disinfectants, properly so called, chloride of lime receives the preference. Chlorides of zinc and iron are dearer, but not more efficient.

The following chapters relate to the economy of the animal system. The chemical changes involved in digestion and respiration are luminously explained. Attention is called to the very hidden relations which may sometimes determine a nation in the choice of its diet. Thus, Ireland has selected for its staple nutriment the potato, a substance eminently deficient in lime. Wherefore? Because its calcareous rocks impregnate the springs and streams with lime, and render a further supply of this mineral to the body needless. When the common articles of food are deficient in salt, the craving for it, in man and beast, is most urgent, and "salt-licks" are eagerly frequented.

The circulation of matter—the mutual relations of plant, animal, and atmosphere—form the topic of the concluding chapter. And rarely have we seen this grand theme—one of the most exalted that science offers to our contemplation—touched at with more eloquence and greater simplicity. We will not attempt to make any quotations, but bid the public read, and then consider whether science, with any show of decency, can still be called "dry, dull, or soulless."

AMERICAN NOTES.—No. III.

Iron Keelsons for Ships and Steamers.—The "Nautical Magazine," published in this city, editorially furnishes a plan of fitting vessels with an iron keelson, *i. e.*, a fore and aft bulkhead made of wrought-iron boiler-plate, rivetted together, and connecting keelson and deck. This plan is practically adopted in the steamer known here as the *Six-day Boat*, designed to run between this and Galway, having very fine lines, a light draught of water, and great proportional power. The organisation, however, under which she was built, having been broken up, she was sold, and is new being completed for the Southern trade.

IRON KEELSONS AND BULKHEADS.

The history of nautical science and of maritime pursuits has established the fact that large ships, whether designed for sailing or steaming, are not strong in proportion to their size; for whilst the small vessel will, in some cases, bear to be sustained by the two ends, having a moderate weight on board, the large ship will not bear stranding without injury. This disparity in the strength arises from two causes. First, the capacity increases as the cubes, while the strength is only proportionate to the mass, and consequently as the squares. And secondly, the buoyancy and the weight are not commensurate in any vessel, and more particularly in large ships and steamers, inasmuch as it often occurs that a section of length at the ends of the vessel is much heavier than a section of equal length in the more buoyant parts; and it is well known that the very extremities of a ship must sustain the ground tackle and other fixtures for the entire fabric, while the buoyancy is much less than the amount demanded by the weight of that section of the vessel itself. This will particularly apply to all longitudinally sharp vessels; and although it is no sign of defect in the model, yet it bears, in its effects upon the ship, unmistakable evidence of the disproportion in her size and strength, in the consequent effect upon the more buoyant sections, in sustaining the less buoyant, but stronger and more weighty ends of the vessel. But whilst this is the manifest result of building longitudinally sharp, and consequently long vessels, the consequences of a want of strength are equally manifest in the vessel having full ends, or with more buoyant bow and stern, when they have attained any considerable size, and (as a result) a proportion of length; although such a vessel, when in a state of rest, is quite competent to sustain, not only its own weight, but that which pertains to this particular locality, such as ground tackle, bowsprit, windlass, &c., yet when plunging into the waves, in storms at sea, she has too much buoyancy, and the bow cannot be kept down, the vessel is partially suspended by the ends, and any extension of pressure, beyond the most moderate application of power, has the tendency to break the bow, and if continued, would part the two extremities from the more central section; hence, it is plain that while the ends of the long and longitudinally sharp ships have not that support demanded by the weight, they must of necessity depend upon the more buoyant parts for the necessary support not furnished in their own sections, and consequently cannot be driven with a degree of power that would cause the overhanging end to protrude beyond the wave by which it is submerged, without hazarding the most fearful consequences, particularly if propelled by steam. It is also equally clear, that the long ship with full ends encounters difficulties equally insurmountable, when driven in storms beyond the most moderate application of power. Thus it is quite manifest, that all ocean steamships, as at present constructed, are propelled at a much heavier cost than is needful for the present amount of strength furnished, or speed attained, consequent upon the expense of their too powerful engines, the power of which can only be used in fine weather, when in reality it is not so much needed as in storms; and from this fact, and this alone, arises the great difference in the length of voyages across the Atlantic of the same ship, beyond what is consequent upon a bad shape, or an ill-shapen model. It is to obviate these difficulties that we recommend these improvements, showing not only the simplest application of those principles of construction, for increasing the strength of large vessels, but of any and every transposition of those principles, continued to the extremities, and taking a longitudinal position in the vessel; and also applying it to iron in the construction of keelsons, whether side or centre, in wooden vessels, which, while they may be so constructed as to occupy no more room than wooden keelsons, are both lighter and stronger.

We cannot regard the time as very far distant when iron keelsons will be universally adopted in wooden vessels of every class. The great necessity for increasing the longitudinal strength of vessels becomes more apparent with every increase of size, added to the increasing conviction of the superabundant strength of their sides, at the expense of the bilge and more central parts, which is exerting a salutary influence on public opinion, growing out of the investigations consequent upon the late calamitous disasters to passenger-vessels. While it is remembered that steam-boats, ocean-steamers, and sometimes sailing-ships, lose their sheer or longitudinal shape when new, before having made a single voyage, it will not be a matter of surprise that some measures should be adopted to remove this most prominent defect in the construction of vessels. It is notoriously true, that if a steam-boat is allowed to lie without machinery for any considerable time after being launched, she loses her original shape, and unless a very considerable quantity of kentledge, or other ballast, occupies the place of the machinery, the boat shows her deformity before her trial-trip; and we have witnessed more than once this departure from original design when being launched, not only in steam-boats, but in ocean-steamers and freighting-ships. If, in launching the vessel, the ways are not sufficiently low at the water, so that their ends form a fulcrum to the smallest extent, the vessel is hogged. If a freighting-ship, or an ocean steam-ship, with good proportions and with but little dead-rise, and having sharp ends, be allowed to remain without cargo or ballast, she loses her shape unless she have centre keelsons far beyond the ordinary depth. On deep vessels, if properly built, the sides will uot furnish an index to this deformity in the bottom; the frame being often cross-plated and rivetted at the crossings, renders the sides of the vessel rigid, not however, beyond their requirements; the planking itself on the sides of the vessel furnishes a very great amount of strength—a benefit the bottom does not enjoy, because the plank can only resist the vertical strain in its single thickness, whereas on the sides the resistance of the plank is edgewise; but, in addition to this, the bottom must sustain the weight of the sides, and, as a consequence, every addition to the strength of the sides, beyond a just equality, operates as though an equal amount of strength was taken from the bottom, inasmuch as the bottom works more, and the sides less, when the ship is at sea. The bilge being borne down by the weight of the sides, has no other relief than that furnished by yielding to the upward pressure on the bottom. Thus we may witness, upon careful examination, the ends of the vessel being borne down, by weight without buoyancy to sustain, while the more central part is pressed up by excess of buoyancy, without weight or strength to keep down; for this contingency the iron keelson makes ample provision, without materially increasing the cost, and may be made subservient to all the purposes of *life-boat construction in the ship itself*, inasmuch as the transverse bulkhead is only rendered efficient in its connexion with the longitudinal one, and cannot of itself but diminish the longitudinal strength. In the study of constructive art, in its application to vessels, the student cannot fail to discover that there is a constant tendency in vessels, when at sea, to yield to the form of the wave, particularly in the direction of the length; and what is most remarkable is, that the part upon which this strain operates with the greatest force has the smallest amount of provision against its influences. The greatest immersed length of a vessel is found at the centre transversely, or from the stem at the bow to the post at the stern ; hence it must be quite clear that the greatest amount of longitudinal strength should be found along this line of length; and inasmuch as the tendency to deflection operates along this line because of its length, so the greatest amount of strength should radiate from this line, inasmuch as the centre of forces operates therein. It must be quite apparent that wooden keelsons, made up of several lengths of timber, cannot secure strength in proportion to the bulk, in addition to the fact, that to obtain an equal amount of rigidity in the bottom by a timber keelson, with that of one of single thickness of plate-iron, would form not only a very considerable part of the cargo, but be more costly and less durable. Iron keelsons may be constructed of single plates, rivetted together and secured to the throats of the floors, either to angle-iron, or to a wooden strake, and may extend to the beams and be secured to the stanchions by screw-bolts; they may be caulked or not, as the case may require; if the vessel is designed for the conveyance of passengers, it should not only be made water-tight, but there should be transverse bulkheads connecting with the centre one, dividing the hold into compartments, each of which might readily be rendered secure against encroachments of fire or flood upon other portions of the vessel.

With regard to the adoption of transverse bulkheads alone, as a safeguard against the dangers of collision, fire, or flood, there can be but one result arrived at by scientific men—viz., that they would increase the danger, rather than remove it, in wooden vessels.

It is a fixed fact, a settled truth, that all wooden vessels yield more or less to the application of propulsory power, both transversely and longitudinally, and approximate very nearly to a complete return to shape, when the power is removed. If this yielding to power in one direction be prevented, it must of necessity be increased in the other ;—hence we say, that if the wooden vessel be made perfectly rigid transversely, the yield will be greater longitudinally. But suppose, with the present want of longitudinal strength in wooden vessels, transverse bulkheads were adopted, and a rupture should take place in the bow, and the water be prevented from coming farther aft than the bulkhead; is it not clear, that this weight of water on the end of the vessel would create a rupture midships, and cause her to founder sooner than she would from the leak itself? But if the longitudinal strength were sufficient to sustain this additional weight, the bulkhead would be a blessing; but without the longitudinal strength, it would be the same in effect as placing a life-preserver at the feet instead of the body of a man to save him from drowning. If the readers of the "Nautical Magazine" will but look at the long list of disasters that take place every month, they will, we think, join with us in regarding this question of assuring life, in the construction of the vessel, of more consequence than any bill before the present Congress; more particularly when we remember that two-thirds of the loss of life and property are directly traceable to deformities generated by the Tonnage Laws, and a want of law in reference to *Life-boat Construction* for passenger-vessels.

New Balance Floating Dry Dock. — The following letter from Wm. H. Webb, the eminent shipbuilder of this city, furnishes the dimensions and particulars of construction, and mode of operation, of the largest floating dock yet known.

"Gentlemen,—I inclose the following description of the New Balance Floating Dry Dock, now being constructed by me for the New York Balance Dock Company.

"Its principal dimensions are 325 feet length, 99 feet breadth, and 38½ feet depth, and the method of construction as follows :—The bottom is formed of two thicknesses of white pine plank, laid transversely, fastened together, and caulked top and bottom with wooden wedges, upon which are placed bb. large oak trusses and counter-trusses, 10 feet high, placed equal distances apart from end to end, and extending from side to side of dock. The sides, formed of large pitch-pine timbers, secured at their lower ends to bottom of dock in the very strongest manner, extending to top or deck of dock, and planked on the outside, are perpendicular, braced, and further secured to bottom by large diagonal braces of pitch pine, extending from outside timbers or uprights to the trusses and bottom of dock. On each side of dock, about 6 feet within the outer timbers or uprights, and extending from bottom to top of dock, a very heavy and strong lougitudinal truss or hog frame is formed of large uprights, top and bottom cords, and large iron bars crossing each other diagonally, the whole being strongly secured to bottom of dock, cross-trusses, diagonal braces, and top deck frame. This hog frame, together with the diagonal braces and top cord of cross-trusses, is planked on the inside, thus forming water-tight tanks the whole length of dock, on each side and bottom, the tanks being subdivided into several compartments, with water communications from each to the other, and to the pumps placed on each side of dock, about midway. The pumps, worked by two horizontal engines (one on each side of dock), of about 300 horses power, and supplied with steam from two large locomotive boilers placed on top deck, are twelve in number, each 30 inch diameter and 3 feet stroke, made of composition, and arranged so as to work at a velocity of one-third that of engines, which, under ordinary circumstances, at a speed of fifty-five revolutions per minute, will deliver about three millions five hundred thousand gallons of water per hour. The mode of operating this immense structure, which surpasses, in capacity, strength, and convenience of operation, anything of the kind extant, is simply as follows:—It is sunk to the required depth by letting in water through a number of gates or valves placed in the sides and ends near the bottom of the dock; then the vessel or vessels (for it is sufficiently large to raise more than one of ordinary size at same time) are hauled in and stationed as desired ; then the sinking valves are closed, the distributing valves opened, and the pumps put in motion, removing the water from the tanks in the sides and bottom, causing the dock to rise aud the water to flow from the interior of dock at both ends, which are open, requiring *no gates*, there being sufficient buoyancy or liftiug power in the tanks to raise the largest class steam-vessel, with all her coals, cargo, stores, aud every necessary thing on board, or the largest steam line-of-battle-ship ever built, with all her armament. coals, stores, crew, and every necessary thing on board, in about ninety to one hundred minutes.

"This dock has all the advantage of a stone dry dock, besides many other advantages, and is considered in many respects superior to any other plan in use. It will be completed in about two months, and put in operation in the port of New York, where it is very much needed.

"Yours truly,

"W. H. Webb.

"To Messrs. Griffiths and Bates."

Freeing Canal-Boats from Water.—A very ingenious method has been invented here for freeing canal-boats of water where the elevation of the canal is such as to admit of the operation of a syphon, the short end being attached to a pipe in the bottom of the boat, and the long end leading over the embankment on one side, and being discharged below the level of the bottom of the boat. This arrangement, as will be readily recognised, is perfectly practicable, economical, and effective; and by the aid of flexible tubes, each boat may carry its own syphon, or resort to the use of stationary ones, at locks, basins, and elsewhere. H.

New York.

GREGORY AND HOW'S PATENT TUBULAR PACKING.

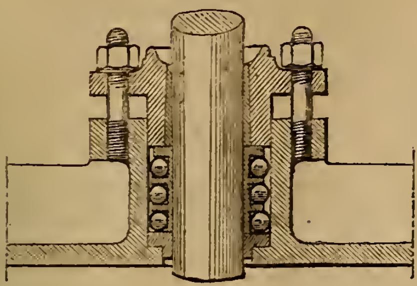


Fig. 1.

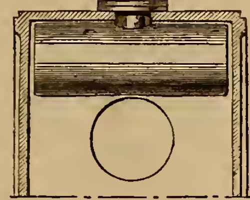


Fig. 5.

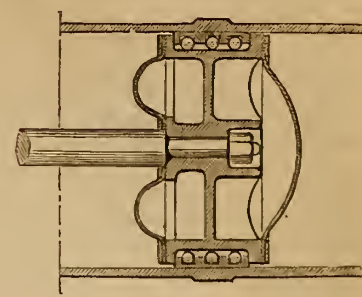


Fig. 3.

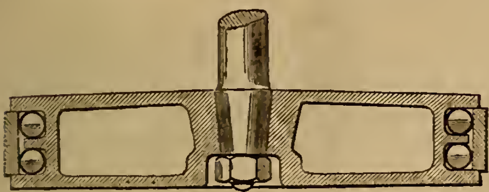


Fig. 2.

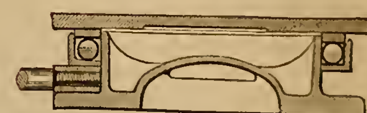


Fig. 4.

The above engravings illustrate a species of combined elastic and metallic packing which the inventors propose to introduce for steam-engine pistons, glands, and other parts required to be packed. Between the metallic rings and the body of the piston or gland, as the case may be, they place a series of annular tubes, partly filled with a liquid substance, which causes the tubes to expand, according to the pressure of the steam acting upon them. The inventors thereby propose to obviate the necessity of having any loose rings, or requiring any screwing down. Fig. 1 shows the application of this packing to a piston-rod stuffing-box; Fig. 2, to a piston; Fig. 3, to a double-acting air-pump piston; Fig. 4, to an equilibrium slide-valve; and Fig. 5, an application of a vulcanised India-rubber air-cushion to the hot-wells of steam-engines, as a substitute for air-vessels, which are at all times unseemly, and frequently unnecessary.

SPECIFICATION OF A DOUBLE DREDGER TO DISCHARGE OVER THE SIDE.

(Continued from page 42.)

STERN CRAB.

The barrel to be 6 feet long, 12 inches diameter at the body, and rise to 28 inches at the flange, and to a central feather same diameter, by which it is to be divided, so that two stern-chains may be worked at the same time. A friction-wheel to be keyed on the intermediate shaft, and be fitted with a weight which may be suspended to the handle, so as to keep a constant strain on the chains if required. A ratchet with palls and guard, slip-clutch and handle, surging-head, ties, &c., to be fitted on this winch, as is more particularly described for the bow-crab.

EXTRA BILGE-PUMP.

The vessel to be supplied with an extra bilge-pump with brass trunk-plunger, worked by the donkey; the chamber to be 6 inches diameter, be connected with bilge-water chest, and discharge into waste-water pipe, or through side of the vessel, as may be afterwards determined on: it is also to be made to fill the boiler when required, and have for this purpose sea and other cocks where necessary; and further, the arrangement is to be such that it will throw water on deck, for washing which it is to be supplied with about 100 feet of best 2-inch leather hose, copper rivetted, with nozzle and other connexions.

HAND-PUMP.

A hand-pump of an approved design, 4 inches diameter, with brass chamber and buckets, to be fitted in a convenient position, be connected with bilge-water chest, and have the necessary pipes and valves, &c., for filling or emptying the boiler.

POWER SURGING-HEADS.

Four surging-heads of cast-iron are to be fixed on vertical spindles at the corners of the vessel, and be driven with gearing from the large engine, so proportioned as to make them revolve about twice its speed; to be mounted in a strong cast-iron frame bolted to deck, with horns cast on for belaying-ropes, slip-clutches, and handles to throw out of gear when required, and fitted with a spring-pall, acting on a wrought-iron ratchet fixed on head. They are to be worked by hand when required, with two winch-handles on a shaft carrying a small bevil pinion, working into a wheel with skew teeth.

SHOOTS.

A shoot to be fitted under each of the upper tumblers, to be formed of $\frac{3}{8}$ plates (except the upper plate, which is to be $\frac{1}{2}$ inch thick), all to be flush-rivetted with $\frac{3}{4}$-inch rivets, $2\frac{1}{4}$ inches apart centres, and caulked. The sole to be in plates one breadth across, butt-jointed on T iron, $5'' \times 5'' \times \frac{3}{8}''$, and the sides joined on 4-inch angle-iron; the upper edges of sides are to be stiffened with coping-iron, $2'' \times \frac{3}{8}''$; the framing of the upper tumbler gearing is to be boxed in with $\frac{3}{8}$-inch plates down to sole of shoot, one side having a space neatly cut out of it for buckets working through; below the shoot, the framing to be lined with 2-inch planks, where required, to keep deck clean and dry. The soles of the shoot to be slightly curved at the upper ends, but flat at the hinges; the flap to be made to lift, when required, by chains on either side rove through a pair of single-sheaved blocks, hung on a bracket at top of framing, the loose ends being worked by a small crab.

PATTERNS.

The patterns to be made from properly-seasoned timber, and well finished, the teeth of the wheels being white plane-tree. The undernoted to be painted, numbered, and inventoried, and delivered along with the machine, as the property of the Clyde Trustees, — viz., wheels, pinions, brakes, bushes, tumblers complete, rollers and brackets, furnace-bars, pulleys, and the core-boxes, and chill-plates for them.

DIMENSIONS, ETC.

The dimensions given are be understood as the sizes finished.

Where only one article may be described, but of which a number is required, the proper quantity must be supplied agreeably to the specification of one.

The whole of the shafts, unless otherwise specified, to be forged from scrap-iron. The body of shafts, and the side of the square of key-seats thereon, to be at least as large as the diameter of the largest journal on the same shaft, an increase of size being made for key-seats and ruffs.

Where only one dimension is given for wheels, it is to be understood as the pitch diameter; where others are given, they are intended for the breadth and pitch of teeth.

Unless otherwise specified, the wheels and pulleys are to be fixed on the shafting with a key and feather, the key-seats being turned, and the eye bored and faced, and the groove in both slotted. The keys and feathers to be inserted across the grain of the iron; all the journals, unless otherwise specified, to revolve in double brass-flanged bushes, with lubricating grooves and holes, the latter covered with brass cups to fit paps cast on covers. The pillow-blocks or brackets to be made of the proper shape for framing, and strongly bolted thereto; cast-iron and oak-fillings being used when required, as may be directed.

All the cocks to be of brass.

The chains to be made short-linked, and from Dixon's extra-best iron.

The machinery generally to be painted with four coats of the best oil-paint.

The metals of the different kinds to be of the best quality, and such as are cast to be of the most suitable alloy for the uses they are to be put to.

STORES AND SPARE GEAR.

The following stores and spare gearing to be delivered along with the dredger, all of the best quality and workmanship; such of them as are duplicates of the working parts of the machine to be similar to those described in the body of the specification, fitted on, and finished ready for putting in.

The machine-boat to be 23½ feet long, and fitted with a ratchet windlass and davit; the punt-boat 17 feet long, with davit; and the service-boat 15 feet long; all supplied with American oak oars, and built from models to be afterwards sent. The stems, stern-posts, and timbers (which are to have double floors), to be natural crooks of British oak; keels, wales, upper strakes, and gunwales, of American oak; rest, of planking-larch or red pine. The machine-boat to have four bound beams, with fore-and-afters between, and iron knees; the others to have three bound beams; and all are to be protected on the bilges, stem, and taffrail, with coping-iron.

The bow-anchor, including stock, to be 12 cwt.; the two stern-anchors, each 6 cwt.; all single-fluked. Kedge-anchors as follows: 1 at 3½ cwt., 2 at 3 cwt., and 2 at 2½ cwt. The following quantities of short-link chain, made from Govan extra-best iron, in 30-fathom lengths, and joined with shackles,—viz., 120 fathoms of 1″ chain for bow-moorings, and 240 fathoms of ¾″ chain for stern-moorings.

One coil of 4″ rope, four of 3½″, two of 3″, and one of 2″; each coil averaging 75 fathoms, and all made of the best St. Petersburg hemp.

The blocks to be made as short as possible, have solid cheeks of malleable iron, and turned iron pulleys; in number as follows, viz.—

2 pairs of threes and fours, capable of lifting	10 tons	per set.
2 pairs of twos and threes,	— 5	—
2 pairs of twos and threes,	— 2	—

All rove with the best bolt-rope falls from 30 to 40 fathoms long.

Two 12-gallon water-casks, with stands and spokes; two good cambooses fitted in galley; a grindstone and stand; 12-feet ladder and a short side one; two shod-bars; four pinches; two brass globe lanterns; and a 50-lb. signal-bell, turned and engraved "Clyde, No. 6, 1855."

In the cabin the following furnishings,—viz., a good stove, standing on a cast-iron hearth, and having a turned cast-iron funnel with hood, which may be taken off, and the port covered with a tompion; a provision chest; a dresser with drawers; two tables, with hardwood tops and drawers; four forms, six stools, and two chairs; a hair mattress and pillow for each berth; and cooking or other utensils of the value of five pounds sterling. In each officer's room, a hair mattress, a chair, and a small table.

In the engine-room, a set of finished screw-keys, marked and hung in a rack; a mat and floor-cloth; two brass lamps in gimbals; 12 tins of various sizes for tallow and oil; and four hammers, 12 files, and as many chisels; saw, adze, hatchet, 6″ vice and board, hand-mallet, and stob-mall, force-brace, and six drills.

In the stoking-room, a complete set of fire-irons, including two hammers and four shovels.

Twenty spare buckets, with single and double links, pins and cutters, complete; two lower tumblers, with shafts and bars complete; one upper tumbler complete, except the shaft; 12 pairs bushes, six bars, and two shafts, all for lower tumbler; eight rollers with spindles, 50 roller-bushes, and six brackets for same.

Engineer's Office, 16, *Robertson Street,*
Glasgow, 27*th October*, 1854.

TENDER.

GENTLEMEN, 13*th November*, 1854.

hereby offer to construct a STEAM DREDGER of 40-horses power, with two rows of buckets, an iron hull, and stores, and maintain the same, all in terms of the conditions and specification thereof, and agreeably to a relative drawing and model, for the slump sum of

in full of all claims; this amount being composed of the following items, viz.—

Iron Hull	£	: :
Engines and Machinery...		: :
Maintenance		: :
Stores and Spare Gear		: :
	£	

Further, willing to construct TWO such Dredgers, including maintenance, stores, and spare gear, in place of one, should you desire ; in this case, offer to execute EACH for the slump sum of

in place of that required by for one only. In the event of these being ordered, bind to supply the first by , and the second by thereafter; the penalty and premium described in the conditions being applicable to these dates for both machines.

In the event of the Trustees preferring the double-cylinder engine described in the specification, will supply it for £ additional to the above price for one dredger, and £ for two dredgers.

Gentlemen,
Your obedient servant,

To the Committee of the Clyde Trustees
on New and Proposed Works.

MR. BRUNEL'S REPORT ON THE GREAT STEAM-SHIP FOR THE EASTERN STEAM NAVIGATION COMPANY.

18, *Duke-street, Westminster*, 5*th February*, 1855.

GENTLEMEN,—The work both of the ship and of the engines has proceeded steadily, and upon the whole satisfactorily, during the last six months.

All the main bulkheads forming the 60-feet compartments, and the longitudinal bulkheads, together with the 40-feet and partial bulkheads, constituting the framing of the middle body, or nearly 400 feet in length of the ship, have been completed, and the plating of the inner skin of the ship is commenced, and already forms a very considerable extent of cover, under shelter of which the longitudinal ribs and the outer skin can be proceeded with in all weathers.

This protection has become the more important, in consequence of the upper deck not having advanced so rapidly as was expected, and the roofing-in from above not having been effected.

The work generally, however, is now arrived at that state at which, with the arrangements that have been in progress during the last month, the contractor will be able to proceed very much more rapidly. Of the engines nearly all the principal parts are cast, the cylinders bored, and the wrought-iron work in a fair state of progress: the boilers are also in hand.

Although the simple description of the present state of the works of the ship and engines, and of what has been done during the last six months, may thus be summed up in a few words, I shall, in compliance with the request of the Directors, embody in this the substance of the several other reports which I have from time to time made to the Court of Directors during this half-year, and take this opportunity of laying before the Proprietors the fullest information upon our plans and proceedings. In doing this it may be difficult to avoid some appearance of repetition of statements previously made; but I have thought it better, even at the risk of this, to refer to the objects we have had in view, and explain fully the nature of the works we have undertaken, and the manner in which we are carrying them out.

The construction of the vessel is the portion of our work which, without being actually novel, involved in all its details the greatest amount of special consideration and contrivance.

The unusual dimensions, the general form and the mode of construction of all the parts involved by those dimensions, the necessity of studying each part in detail so as to obtain, by judicious mode of construction alone, the greatest amount of strength with the minimum amount of material—all these circumstances, and particularly the last, have rendered necessary a very large, though unseen, amount of labour in the preliminary plans and stages of the work; and although I had for nearly two years before the contracts were entered into devoted a great deal of time and thought to the subject, yet, of course, until the exact size of the vessel and the general plans of the Company had been finally determined upon, none of these matters could be gone into in detail. Much time has consequently been required to mature and prepare these plans; and as I have made it a rule from the first that no part of the work should be commenced until it had been specially considered and determined upon, and working drawings in full detail prepared, and after due deliberation formally settled and signed, the work did not make at the onset that display of progress which might have been made, if less regard had been paid to establishing a good system which would prevent delays hereafter and insure a more perfect and satisfactory result. I am not prepared to say that the work is in that state of progress which will insure its completion within the period fixed in the contract; but I am quite certain that if we had proceeded with less system, we should have considerably delayed the final completion.

One of the first points to be decided was the mode of launching the vessel, which, of course, would determine the position in which it was to be built; and I wish to take this opportunity of explaining my reason for adopting the plan I have decided upon, which, being unusual, might be supposed to be unnecessary.

Vessels are generally built above the level of high water, and then allowed to slide down an inclined plane into the water: occasionally, as in the case of the *Great Britain*, they are built in a dry dock, into which the water is afterwards admitted and they are floated out.

Both plans were well considered in the present case; but the size of the dock required, the difficulty of finding a proper site for such a dock, the depth required for floating a ship with her engines and boilers, which it was most desirable to introduce while building the hull, and the depth of channel required to communicate between such a dock and the deep water of the river—all combined to render the dock plan a very expensive, and, considering the nature of the soil in which it would have to be formed, a somewhat hazardous proceeding. Launching seemed to offer the fewest difficulties and the greatest certainty; but the dimensions of the vessel required some modifications of the usual modes of proceeding.

Launching is generally effected by building the ship on an inclined plane, which experience has determined should be at an inclination of about 1 in 12 to 1 in 15, the keel of the ship being laid at that angle, and the head consequently raised above the stern say one-fifteenth of the whole length of the ship. In the present case, this would have involved raising the fore part of the keel or the fore foot about 40 feet in the air, and the forecastle would have been nearly 100 feet from the ground; the whole vessel would have been on an average 22 feet higher than if built on an even keel.

The inconvenience and cost of building at such a great height aboveground may be easily imagined, but another difficulty presented itself which almost amounted to an impossibility, and which has been sensibly felt with the larger vessels hitherto launched, and will probably, ere long, prevent launching longitudinally vessels of great length. The angle required for the inclined plane to insure the vessel moving by gravity being, say 1 in 14, or even if diminished by improved construction in ways to 1 in 25, is such, that the end first immersed would become water-borne, or would require a very great depth of water before the fore part of the ship would even reach the water's edge. Vessels of 450 or 500 feet in length would be difficult to launch in the Thames, unless kept as light as possible; but our ship could not be so launched, the heel of the stern-post being required to be, as I before said, about 40 feet below the level of the fore foot. Some mitigation of the difficulty might be obtained by an improved construction of the ways; but the great length of ways to be carried out in the river would, under any circumstances, be a serious difficulty.

These considerations led me to examine into the practicability of launching or lowering the vessel sideways; and I found that such a mode would be attended with every advantage, and, so far as I can see, it involves no countervailing disadvantages. This plan has been accordingly determined upon, and the vessel is building parallel to the river, and in such a position as to admit of the easy construction of an inclined plane at the proper angle down to low-water mark.

In constructing the foundation of the floor in which the ship is being built, provision is made at two points to insure sufficient strength to bear the whole weight of the ship when completed. At these two points, when the launching has to be effected, two cradles will be introduced, and the whole will probably be lowered down gradually to low-water mark; whence, on the ensuing tide, the vessel will be floated off. The operation may thus be performed as slowly as may be found convenient; or if, upon further consideration, more rapid launching should be thought preferable, it may be adopted.

I have entered at some length into an explanation of all the reasons which led to the adoption of this plan, as I am anxious that they should be known, and particularly that it should be well understood by the Proprietors, and those interested in our success, that I am not adopting any novelties—unless so far as those modifications of the more usual practices which experience points out as necessary to meet the peculiarities of a particular case may be deemed such.

I should add, that the necessity, arising from the same causes, of launching transversely has been felt with long vessels of another description; namely, pontoons, or floating piers. One of 300 feet in length, which I have built at Plymouth, was so launched; and previously to this, one of 400 feet in length, by Mr. Fowler, on the Humber.

I hope to be able to arrange that the machinery which is to be provided by the contractor for lowering the vessel down the ways will be also fitted to form a "patent slip" arrangement for hauling the ship up for repairs; so that, if it should be found desirable to do so, such apparatus may be purchased for that purpose, and fitted up at the port which the ship will frequent. With the view of facilitating such an operation, or the grounding of the ship on a gridiron for examination at low water, a sufficient extent of the floor of the ship is formed perfectly flat, and is so strengthened as to allow the ship, when loaded, being grounded without being unduly strained.

I shall now refer to a few of the principal peculiarities in the construction of the ship.

In the preparation of the detailed plans, I have carried out fully those principles which I originally described as leading features of the construction.

The whole of the vessel is divided transversely into ten separate, perfectly water-tight compartments, by bulkheads carried up to the upper deck, and consequently far above the deepest water-lines, even if the ship were water-logged, so far as such a ship could be; and these being, not nominal divisions, but complete substantial bulkheads, water-tight, and of strength sufficient to bear the pressure of the water, should a compartment be even filled with water; so that if the ship were supposed to be cut in two, the separate portions would float, and no damage, however great, to the ship's bottom, in one or even two of these compartments, would endanger the floating of the whole, or even damage the cargo in the rest of the ship, or above the main-decks of the compartment in question, and all damageable cargo would be stowed above that deck. Besides these principal bulkheads, there is in each compartment a second intermediate bulkhead, forming a coal-bunker, and carried up to the main-deck, which can on an emergency also be closed. There are no openings under the deep water-line through the principal bulkheads, except one continuous gallery or pipe near the water-line through which the steam-pipes pass, and which will be so constructed as to remain closed—the opening being the exception, and the closing again being easy; and the height being such that, under the most improbable circumstances of damage to the ship, ample time would be afforded to close it leisurely, and to make it perfectly water-tight. I have also adopted the system, to be followed rigidly and without exception, of making no openings whatever, even by pipes and cocks, through the ship's bottom or through the inner skin below the load water-line, and I attach much importance to this system.

In the majority of cases in which steam-boats are compelled to put into port from failure of bilge-pumps and other really trifling defects, no such serious consequence would have resulted, but from the difficulty and almost impossibility of remedying at sea any defects in the numerous pipes and openings now carried through the ship's bottom wherever convenient, and without much regard to the danger of doing so.

I have found no great difficulty in carrying out this system completely; and the advantages, both as regards safety and the facility of remedying defects without delaying the ship on her voyage, must be obvious.

Independently of the security attained by the perfect division of the ship into really water-tight compartments, of a sufficient number that the entire filling of one or even two of them will not endanger the buoyancy of the whole, the chances of any such damage as can cause the filling of one of them are greatly diminished by the mode adopted in the construction of the ship's bottom. The whole of the vessel (except the extreme stem and stern, the whole buoyancy of which is comparatively unimportant from the fineness of the lines), up to a height considerably above the deepest water-line, is formed with a double skin, with an intervening space of about three feet. This arrangement resulted originally from the system of construction I adopted, in which the bulkheads placed at intervals of twenty feet form the main transverse frames or ribs of the ship, and in the intermediate space the material is disposed longitudinally in webs connecting the two skins, giving to the whole much greater strength with the same amount of material; but one of the most important results has been the great increased security attained, as the outer skin may be torn or rent against a rock without causing the ship to leak.

The space between these two skins is thus divided, by the longitudinal beams or webs and the principal bulkheads, into some fifty separate water-tight compartments, any one or more of which may be allowed to fill without materially affecting the immersion of the ship.

Besides the main transverse bulkheads, at about sixty feet intervals, there are two longitudinal bulkheads of iron running fore and aft, at about forty feet in width, adding greatly to the strength of the whole, and forming with the transverse bulkheads — being all carried up to the upper deck—fire-proof party-walls; cutting up the whole into so many separate parts, that any danger from fire may be almost entirely prevented.

The transverse bulkheads being perfect, there being only one door—and that of iron—in each, at one of the upper decks, all currents of air or means of communicating fire may be completely cut off; and with an additional precaution, which I will refer to afterwards, besides the most ample means of supplying water, I believe that all possibility of danger from fire may be completed prevented.

All these principles of construction being kept in view, the details of construction—that is, the arrangement and due apportionment of the strength and sizes of all the plates and the mode of fastening them—having been determined separately, the plates have been made at once, of the required dimensions, and the work has proceeded systematically. This system is the more important, as securing uot only good work, but effecting to a much greater extent than might at first be supposed the total weight of the ship, which, although the terms of the contract protect the Company against any excess of expenditure beyond a certain fixed sum, is yet of the greatest importance, as will be easily understood when I mention the fact that several merely trifling alterations in the modes of arranging the plates and other details have caused an economy of twenty to fifty tons each, and that the vessel may be thus made capable of carrying 200 to 300 tons more of coal, cargo, or provisions; or iron to the same amount may be usefully applied to strengthen other parts or effect useful additions.

The details of the engines have all been settled; and the principal parts, as already stated, are in an advanced state of completion.

In considering the plans of those engines, the largest that have yet been manufactured, I have endeavoured to ascertain what may be termed the weak points of the best engines hitherto constructed by the same or by other makers — those points in which experience has pointed out deficiencies—and to provide fully against similar defects in our case.

Before commencing the boilers, I have taken every means in my power of profiting by the experience of others, and have collected all the evidence and opinions as to the precise form and proportions which have been found most efficient, and particularly such as have been found best suited to the combustion of anthracite coal. A very great difference is found to exist in the useful and economical results of boilers, even of good manufacture. Some are noted for the power of producing rapidly abundance of steam, at the cost of great consumption of fuel; others have the opposite qualities, and some combine successfully both those qualities which are desirable. It might have been supposed that all points of such a simple subject would have been long since settled, and that no boiler would be made inferior to the best. Such is not, however, the case; and although the differences of construction are in themselves slight, the difference of result is often considerable.

I have takeu some pains to satisfy myself on these points, and have endeavoured to select aud to copy the most successful boilers; and in order to remove all doubts as to their fitness for the use of anthracite, I have made an experimental boiler, and after numerous trials determined upon the form and dimensions to be adopted.

In the consideration of these details, as indeed on all other points affecting the success of this undertaking, I have not hesitated to consult everybody whose opinions I considered valuable, aud to bring the result of their opinions in aid of my own and the manufacturer's experience.

I have only to add, that after giving much consideration to the question of the diameter of the paddle-wheels and screw, I have determined them sufficiently for fixing the position of the shafts, aud am now engaged in considering the best form and construction of the propeller itself, and also the construction of the stern-frame and rudder of the ship.

The position of the paddle-shaft and the diameter of the paddles have been questions of some difficulty. It being necessary to provide for a considerable variation in the draft of water, though not proportionably so great as with many existing large steamers, and to balance well the relative advantages of securing the highest average speed, at all the various drafts, or the highest speed at a light draft, and to combine as far as possible the two, so that the vessel may be as well adapted to perform comparatively short and very quick passages to ports not affording a great draft of water as long voyages heavily laden, at a more moderate maximum, but still a large average rate of speed. Although the full advantage of the great capacity of the vessel for carrying coal for long voyages would not be felt in a voyage, for instance, to New York, or in other short voyages, yet, unquestionably, she would exceed all other vessels in speed and extent of accommodation; and if it should be found desirable to make such voyages, your vessels ought to be able to command almost a monopoly by their superior capabilities, and I have therefore endeavoured so to place the paddle-shaft, aud so to construct the wheels, that they can be adapted to the convenient application of the full power of the engine at a light draft of water and at a very high speed.

As regards the screw, the same points have to be considered, and a choice made amongst the various forms and proportions more or less successfully adopted at the present time. I have always found the reports made upon the results of the various forms of screws and propellers, and the performance of differeut vessels, so little to be depended upon, even when apparently made in good faith, and the results obtained from good authority, that I have been long since compelled to adopt no conclusion unless from results witnessed by myself or by persons observing for me. I have for some time past availed myself of every opportunity that offered of observing and obtainiug something like accurate results upon the various points affecting immersion of paddles or screw, and I am engaged in considering those results.

I have referred to the subject of protection from fire: it is one of considerable importance, and I have some hopes that a process, which has been recently patented by Lieutenant Jackson, may be successfully applied to rendering wood uninflammable. Some door-panels have been already experimented upon, with results which have induced me to pursue the experiments, and I am about to try the comparative inflammability of various qualities of wood, both prepared and unprepared; and if we can succeed in preventing the wood producing a flame, and thus communicating the fire with the numerous metallic subdivisions we shall have in the ship, the spreading of fire, even from cargo or furniture, would become impossible. I am also engaged in determining the character and extent of mast and sail to be carried, as provision must now be made in the construction of the ship for receiving the masts.

The Directors are aware that I have been in communication with Professor Airy, as to the instruments which may be used in such a ship to insure more accurate and frequent observations; and as to the nature of these observations, an inquiry into which he has entered with that liberality and desire to assist all improvements, in navigation especially, for which he is so well known, several new instruments are uow making for trial.

Sir W. Snow Harris has promised to turn his attention to the subject of the lightning conductors; and as soon as the iron-work is a little more advanced, and while the form and position of all the principal masses are visible, the subject of local attraction and the adjustment of the compasses will be considered by those most competent to advise, and I am not without hope that the meaus of correction may be rendered much more certain and perfect than usual. I mention these, as some of the numerous poiuts which require and are receiving attention.

I am, Gentlemen, your obedient servant,
(Signed) I. K. Brunel.

To the Directors of the Eastern Steam Navigation Company.

INSTITUTION OF MECHANICAL ENGINEERS.

On an Improved Wrought-Iron Piston.

By Mr. James E. McConnell, of Wolverton.

This piston is constructed entirely of wrought iron, and it is forged in one piece with the piston-rod, by means of which the ordinary joint between the piston and piston-rod is avoided, and a great saving of weight is effected.

The construction is shown by the drawings, which represent an 18-inch piston for a locomotive engine.

Fig. 1 is a trausverse section of the piston;

Fig. 2, a side view of the cover, detached from the piston;

Fig. 3, a sectional plan, showing the interior.

The body of the piston, A A, is a circular disc of wrought iron, which is forged under the steam-hammer, with a portion of the piston-rod, B, formed upon it, about 9 inches long, to which the piston-rod is afterwards welded. The circular ring, C C, is also raised upon the disc in the forging, thus completing the body of the piston in one solid piece of wrought iron.

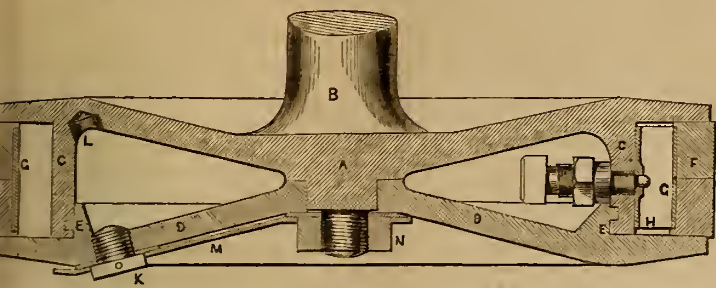


Fig. 1.—Section.

The wrought-iron cover, D D, is screwed into the ring, C C, by a single thread cut upon the projecting rim, E E, on the inner side of the cover, as shown in the detached view of the cover, Fig. 2.

The cover is dished in the centre as well as the body of the piston, so that the two sides meet in the centre, to diminish the weight of material.

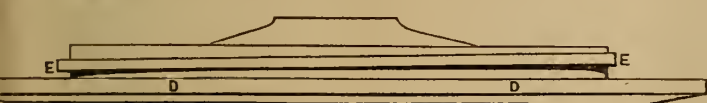


Fig. 2.—Elevation of Cover.

The packing consists of two plain brass rings, F F, lined with a thin steel hoop, G, which fit into a shallow recess on the inside of the brass rings. The four steel springs, H H, are set out against the packing by set screws fixed in the ring of the piston, C C. The fifth set screw

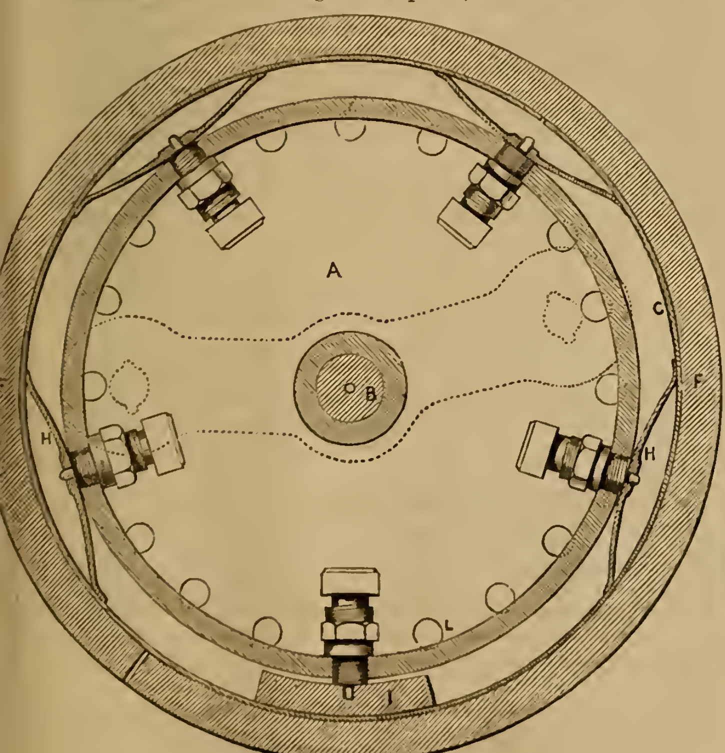


Fig. 3.—Plan.

is attached to a solid block, I, which is placed at the bottom of the piston, and serves to support the weight of the piston, to prevent it from fluting the cylinder.

Two holes, K K, are provided in the cover for the purpose of unscrewing it, by means of a bar passed through either hole, K, and bearing at the point in a series of holes, L L, sunk in the opposite side of the piston. The holes, K K, are closed by brass screwed plugs, which are kept from turning by a thin brass plate, M, fixed by split pins, as shown in the detached plan, Fig. 4. This plate also secures the brass locking-nut, N, for preventing the cylinder cover from unscrewing: the thread of this nut is right-handed, whilst the main thread of the cover is left-handed.

The weight of this piston, including the piston-rod, is 217 lbs. for the size shown, 18 inches diameter, which is 89 lbs. lighter than the ordinary construction of pistons of the same size, weighing 306 lbs. The weight of a 16-inch wrought-iron piston and rod is 160 lbs., being 47 lbs. lighter than the ordinary construction.

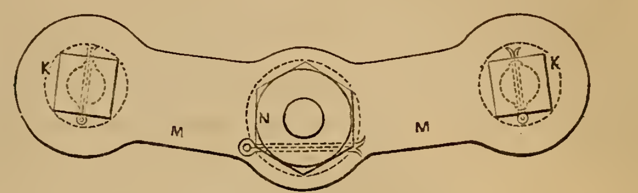


Fig. 4.

This saving of weight amounts to 178 lbs. in the pair of 18-inch pistons, and 94 lbs. in the 16-inch pistons, which is a point of considerable importance at the high speed of 600 to 800 feet per minute, at which locomotive engine pistons are driven; the consequent reduction of momentum adding to the durability of the working parts by reducing the strain upon them, as well as diminishing the disturbing effect upon the motion of the engine.

The solid construction of this piston avoids all risk of accident from the piston working loose upon the rod, which in the ordinary construction is liable to cause the fracture of the cylinder-covers, and sometimes more extensive injury.

There are upwards of 200 of these pistons now in use, and some of them have been at work for two years. The lightness of the piston, and the accuracy of adjustment maintained throughout, in consequence of the absence of joints and loose parts in the construction, allow the brass packing-rings to be worn down to a greater extent than usual before requiring renewal. These rings, of which specimens are exhibited to the meeting, have been worn down to $\frac{1}{8}$th inch from the original thickness, $\frac{3}{4}$ths inch, and lasted twelve months in constant work.

Mr. McConnell exhibited one of the pistons, 18 inches diameter, and showed the process of taking off the cover, and screwing it on again; also specimens of brass packing-rings that had been worn down.

The Chairman remarked that there was great ingenuity and compactness in the construction of the piston, and the saving in the moving weight was very considerable, and was a point of importance, as well as the avoidance of a joint between the piston and piston-rod.

Mr. McConnell said the object had been to obtain a piston constructed entirely of the toughest and strongest material, wrought iron, as light as possible, and in as few parts as possible: the piston and rod indeed consisted of only two separate parts besides the packing rings and springs; the cylinder was also shortened and made lighter by the piston being thinner. The greater accuracy of adjustment allowed the packing-rings to be worn down thinner than usual; those shown had been worn down to $\frac{1}{8}$th inch from $\frac{3}{4}$ths inch thickness, in about nine months' work.

Mr. Chellingworth observed that one of the rings had been worn somewhat unequally, being nearly $\frac{1}{16}$th inch difference in thickness at the two ends.

Mr. McConnell said the variation had probably been caused by a little difference in the pressure of two adjoining springs, arising from their not being adjusted quite equally: the rings had generally been found to wear down very uniformly.

The Chairman inquired whether any difference had been found in the amount of wearing the cylinders oval?

Mr. McConnell said the difference had not been noted, but there would be a less effect in disturbing the form of the cylinder, from the piston being one-third lighter than ordinary pistons, as the wear was caused only by the weight lying on one side.

The Chairman asked whether any disadvantage had been found from rusting of the iron in the interior, the piston being all made of wrought iron; and whether it had been tried in any stationary engines?

Mr. McConnell replied that the joint of the cover, where it was screwed in, fitted so well that water could not get in; and the water being prevented from entering the piston, preserved the interior from rusting. The piston had only been tried at present in locomotive engines, and the construction was most applicable to small quick-moving pistons.

The Chairman proposed a vote of thanks to Mr. McConnell, which was passed.

REMARKS UPON THE USE OF PHONIC SIGNALS IN NAVIGATION.

By Prof. John C. Cresson, C.E.*

Among the numerous suggestions elicited by the melancholy loss of the steamer *Arctic* for the prevention of such disastrous collisions, there is none that appears so easily attainable as the use of the steam-whistle, or, more correctly, steam-trumpet.

The proper mode of using this instrument being, therefore, a matter of some importance, a few remarks, based upon experimental knowledge, may be a not inappropriate contribution to the pages of the "Journal."

It is well known that the blast of a large steam-trumpet is distinctly audible at the distance of five miles; and instances are known of its being heard at more than twice that distance in cloudy weather.

It has been found, also, that this peculiarly abrupt sound is well adapted for the formation of distinct echoes, and at sea its echo from a bluff coast or a ship is very remarkable, so as to be quite startling when heard for the first time in darkness or fog. The writer took part in some trials of it on the Bay of Fundy, which proved that this echo would give notice of approach to a rocky headland distant several miles, and of a small schooner more than a mile off.

May not these qualities of the steam-trumpet be so applied as to make it not only give a warning signal to others outside the ship, but also to return the warning to the ship giving it? If so, how is it best to be accomplished?

Experiment has shown that a loud, abrupt sound produces a complete impression on the sense of hearing, if its duration be only one-eighth of a second of time; and, further, that sound travels through the air at the rate of a sea-mile in about five and a half seconds. A vessel running at twelve knots passes over a sea-mile in five minutes; so that two vessels three miles apart, running head on at this rate, would come together in seven and a half minutes. A consideration of these facts leads to the following practical conclusions as to the proper mode of using the steam-trumpet in dark or foggy weather.

Instead of blowing it continuously for any length of time, it should be blown in short, abrupt blasts, with a considerable interval of silence, the length of which should be varied with the speed of the vessel and other circumstances.

As a blast continuing an eighth of a second is audible, we may safely depend upon making a good impression on the ear, even at a distance, by giving it sixteen times that duration, or two full seconds. This could be heard at sea for the distance of five or six miles, and its echo from any large object above the horizon would be audible when two or three miles off. The intervals of silence ought to be such that two vessels three miles apart could not come together between two consecutive blasts, if running right head on. If their united speed be not more than twenty-four knots, it will be quite safe to allow five minutes, as there would be at least two blasts returned by echo to the vessel making the signal, and many more audible to the watch on the other vessel, before they could come into contact.

The quantity of steam required for such use of the trumpet would be less than one-hundreth part of that consumed in sounding it continuously; and even if the intervals between the blasts be reduced to two or three minutes, it would use but an insignificant amount of steam, probably not one-tenth of a horse power.

* From the "Journal of the Franklin Institute."

Another advantage accruing is, that this mode of signalling not only gives warning of approaching vessels, but also will make known the proximity of icebergs and headlands, or any other large object above the horizon: it may even, in cloudy weather, give warning of land many miles beyond the horizon, by means of the reverberation from the clouds to the land, and back by the same course.*

The interval of silence also allows the look-out man to hear any signal given by another vessel in reply to his own.

To obtain the best effect from the trumpet, it should be placed forward of the smoke-pipe, elevated 20 or 30 feet above deck, and be provided with a bell-shaped reflector that will project the sound strongly forward, and limit its range to 60 or 90 degrees of azimuth.

The signal-man should have his place of look-out at the bow of the vessel, where he should have a small pent-house screen or shelter directly above and behind him, so as to protect his ears from the intensity of the sound of his own trumpet, and thus preserve his acuteness of hearing for catching the feebler echoes returned by very remote objects. A coarsely-made time-keeper, with a strong chronometer escapement beating full seconds, should be provided and placed under the small pent-house, in view of the signal-man, by the beats of which he might regulate the duration of his blasts and the intervals of silence, and might also, by counting beats between a signal and its echo, estimate the distance of the echoing object. The right method of proceeding is this:—at night, and in fogs, let the look-out man make his signals regularly, according to orders, say every four minutes, keeping up the sound for two seconds or beats of his time-keeper. The regularity with which he performs this will be a good indication of his vigilance.

Should he at any time hear an echo, he must repeat his signal at a half interval, say two minutes, and immediately count the beats of his time-keeper until the echo is again returned. Should the time be long, say as much as thirty seconds, he will know that the stranger is about three miles off, and he may again give his blast in the half interval of two minutes; should the observed time of this third echo be as great as before, he must continue his signals at half intervals until he observes a change in the time of the return of the echo; should it become shorter, he must give his signal sooner, say at a quarter interval of one minute, and so on. Should the time of the echo become longer, he may lengthen his interval to three minutes; and if the echo ceases, he may return to his regular four-minute interval.

The velocity of sound being, approximately, a sea-mile in five seconds, and the echo requiring time to go and return, the distance of the echoing object is to be estimated at a mile for every ten seconds; or when greater accuracy is desired, it is to be taken at a mile for eleven seconds.

Now, let us consider for a moment the results of these proceedings. In the first place, the man on look-out has been giving notice to all on board that he is at his post and awake, which satisfactory announcement will continue without change so long as nothing above water nears the ship. As soon as there is anything ahead large enough to give an echo, the change of interval between the signal-blasts gives immediate notice of the fact to the officer on duty, and all others on watch: the officer can at once make his own observations as to the nearness of the approaching object, and its rate of approach. Experience will soon enable him to judge pretty correctly with regard to its position, its size, and its general character; that is, whether it be a ship or an iceberg, a rock or a coast. The engineer having received the same warning, is prepared to stand by for stopping or reversing, and the helmsman is on the alert for orders to change his course.

A system of phonic language may easily be devised for giving all the requisite information by approaching vessels of each other's course and intended movements. Railroad engine-men have a very simple system of conveying such knowledge with great precision. Should the steam-pressure of the engine be too low to produce an energetic blast, a small furnace and boiler, occupying but half the space of a cook's galley, would furnish abundance of high steam.

On sailing-vessels, a hand force-pump or bellows for compressing air into a strong receiver would answer every purpose.

As these abrupt trumpet-blasts will be more unlike the ordinary sounds heard on ship-board at sea than a continuous sound would be, they will more effectually arouse attention; and this tendency might be further increased by making the blast suddenly change its tone, as is done in the Indian whoop, in which an abrupt rise in tone, to the extent of an octave or more, gives a peculiarly startling effect.

Philadelphia, Nov. 24th, 1854.

* A curious illustration of the reflection of such sounds by clouds has recently been observed upon a railroad in this State, which crosses one of the principal mountains in the anthracite coal-field of Schuylkill county; the steam-signals given by a locomotive in the Mahanoy Valley, north of Broad Mountain, being distinctly heard, in cloudy weather, at a station ten miles distant, on the south of the mountain. The height of the interposed mountain above the two points was over seven hundred feet.

NOTES BY A PRACTICAL CHEMIST.

Relative Value of Alcohol and Wood Spirit as Fuel.—According to the experiments of Bolley, the heating capacities of alcohol and wood-spirit are respectively as 6 : 7; and as alcohol is dearer than wood-spirit in the proportion 8 : 6, the latter is nine-fourteenths cheaper as a fuel.

Dung Substitutes in Calico Printing.—Cow-dung contains alkaline silicates to a considerable extent. Recent moist dung yields, on incineration, 2·6 per cent. of ash, of which 62·5 per cent. is silica. Of the soluble portion of the ash (38 per cent.) 12 per cent. is silica, and 10 per cent. potash and soda. Silicate of soda may, therefore, be regarded as the active ingredient of cow-dung. Koechlin found that the constituents of mordants are met with in the dung-bath after being used, and that the alumina is in solution. Hence, we conclude that the dung-bath dissolves a part of the aluminous mordant. In what manner this is effected, what is the solvent, and why the alumina is not precipitated, are points yet unknown. But aluminous salts, and even alkaline solutions of alumina and phosphate of alumina, are decomposed by silicate of soda, and an insoluble silicate of alumina is formed. Silicate of soda employed alone has the advantage of rendering the colours deeper than if the dung-bath were employed.

Treatment of Pyritic Ores containing Silver and Copper with an excess of Zinc.—When ores consisting chiefly of iron pyrites, and containing traces of copper and silver, are smelted in the blast-furnace in a semi-roasted condition along with proper fluxes, so that a copper matte may be obtained in which the amount of copper and silver is worth extraction, it is possible to drive off a large amount of zinc (originating from blende), and thus obtain a matte fit for treatment with lead, by fusion, *e. g.*, with argentiferous galena and earthy silver ores. When the smelting is conducted in a furnace with open breast, and the blast is sent horizontally into the melting-chamber, the zinc is driven off in vapour and oxidised. Thus, a matte is obtained, presenting, when cool, an orange yellow fracture with faint lustre, and consisting of sulphides of copper and iron, with silver, and occasionally lead. The amount of zinc is rarely 3 per cent. But if the ore be smelted in a partially roasted state in a reverberatory furnace, the blende is not decomposed, and passes chiefly into the matte, which, when cool, is hard, black, of feeble lustre, and granular micaceous fracture. The zinc may amount to 20 per cent. Where zinc is abundant, the roasting is far more difficult and tedious. It may, however, be decomposed by being heated with oxide of iron in fine powder. Thus, if the pyrites to be smelted should contain a large proportion of black blende, which contains 23 parts sulphuret of iron with 77 sulphuret of zinc (the latter containing 51·6 zinc with 25·4 of sulphur), and it is wished to drive off the zinc, 63·4 parts red oxide of iron must be added, and 7·1 parts of carbon, for its reductions. From various causes, these proportions should be rather exceeded in practice, as, *e. g.*, 70 parts oxide of iron and 10 parts of coal-dust. The addition of slags containing protoxide of iron and mono-silicates, such as the slags from smelting with lead, or well-roasted pyrites, is generally useful. If alumina is deficient, silicious clay should be added; and if lime is wanting, quicklime or fluor-spar: the latter is particularly valuable. If the oxide of iron be used for decomposing the blende by roasting a pyritic ore containing blende, the operation must be performed in a reverberatory furnace upon the ore in fine powder, at a temperature of 800°, attained gradually, and with a plentiful admission of air.

Muntz's Sheathing Metal.—We have received specimens of this alloy, both in a recent state, and after various periods of immersion in salt water. The former are of a light yellow colour, of a compact fracture, and resist a very considerable strain; the latter exhibit a deeper reddish brown colour, the fracture is coarsely granular, or rather pulverulent, and they crumble under the pincers, or even under the fingers. The surface was covered with an incrustration, consisting of oxide and carbonate of zinc tinged with salts of copper. The whole was evidently undergoing a complete disintegration, arising, as our correspondent suggests, from galvanic action between the copper and zinc. In confirmation of this view, we may mention that the crumbling portions yielded, on analysis, a smaller percentage of zinc than the fresh metal. We have placed portions of the metal in various saline solutions, and shall report the result on a future occasion. Meantime, we are decidedly of opinion that the metal in question, and all other alloys whose ingredients hold very different positions in the electro-chemical scale, are utterly unfit for any purpose where strength and tenacity should be preserved after prolonged immersion in sea-water. S.

AGRICULTURAL ENGINEERING.

Dry Clay Brick-making Machine.

By M. A. Julienne, Paris.

(Illustrated by Plate xxxiii.)

In the "Génie Industriel" for December last, we find an account of a machine invented for the manufacture of bricks from dry clay. We think it will interest our readers to give an abstract of the article and the drawing. The machine is simple in construction, and can be worked quickly and with ease. In a day of ten hours, a man and a boy can with it make 4,000 bricks.

Fig. 1, Plate xxxiii., is a longitudinal section;
Fig. 2, a plan, and
Fig. 3, transverse section of this machine.
Fig. 4 is a horizontal section at the motion-shaft.

The machine consists of a strong wooden frame, A, supporting a cast-iron frame, BB′. Between these are the moulds, which are a double case of wood, C, forming two rectangular openings of the size and length of a brick, lined with sheet copper. The uprights, D, carry two horizontal shafts, E and F. At the end of the shaft E, is the lever, I. The same shaft has two small arms or levers, K, cast on it, to which are attached two chains, *k*, having their lower ends fastened to the frame, L, which forms two rectangular pistons, L′, corresponding exactly with the moulds, C. Each time motion is given to the shaft, the arms, K, acting upon the chain, raise the pistons, L′, into the moulds. In their upward motion the pistons are guided by moulds themselves; in the downward motion, by a transverse piece, M, which at the same time holds together the uprights, D. On the shaft, O, in the bearings, R, is a pressure-beam, N, with two pieces of wood on the under side, acting on the tops of the moulds. The clay having been put in, the pressure-beam, N, is brought down, and the lever, I, acting upon the pistons, L, exerting a considerable force, presses it into the moulds, C. The pressure-beam is then put into the position shown in the dotted lines, N³; the lever, I, put back; and the bricks are released from the moulds by the action of the lever, S, on the end of the shaft, F, which has in its centre a smaller lever, S′, with a chain and pulley fastened to the frame, L, carrying the pistons.

RAMBLES AMONG THE REAPERS.

By R. S. Burn.

(Continued from page 40.)

Mr. Ogle's Reaping-machine, alluded to at the close of last article, may be briefly described as follows:—The framework, closely resembling the skeleton of a common cart, was *drawn* by the horse (not pushed), walking by the side of the uncut corn. On one side of the carriage the cutting-apparatus projected. This was constructed of a light frame of iron, from which teeth, three inches long, projected. The cutter, a straight-edged knife, lay upon these teeth; and the whole had a vibratory motion, from side to side, given to it. The corn was brought up to, "or lashed backward upon," the knife by a revolving vane or rake. The corn, as it was cut, fell upon a platform immediately behind the knife, and hinged to the back of the frame on which the knife worked against. This platform was kept raised in an inclined position until as much corn was collected as was sufficient to make a sheaf, when the platform was allowed to fall by working a lever which held it in position, and the corn was allowed to slide off to the ground. In practice, however, this delivering apparatus did not act so well as expected; and, in consequence, the plan adopted, and found to answer, was collecting the cut corn by a hand-rake until as much was obtained as formed a sheaf, and then discharging it. The vibratory motion was given to the knife by means of a γ-shaped instrument, or lever, vibrating on a centre somewhere near the middle of its length. The ends of this lever were alternately acted on by the cogs projecting from the inside face of the main wheels of the machine. A vibratory motion was therefore given to the straight end of the lever, which being attached to the knife-frame, communicated a similar motion to it. This machine was tried at Alnwick in a field of barley, which it cut and laid out in sheaves extremely well. Nevertheless, although Messrs. Brown advertised, in the beginning of 1823, their readiness to supply machines to farmers, the invention took no hold of the public attention. The inventor, therefore, was forced to allow the machine to remain in quiet seclusion, partly induced, perhaps, thereto by the threat which some working-people held out to the manufacturers, that, if persisted in, they would be killed. So that, on this account, the inventor of this machine may be added to swell the list of those who have been prevented from doing good to their fellow-men from an absurd apprehension that their works were calculated to do harm to those whose labour is done by the sweat of the brow.

In 1826, the celebrated reaping-machine known as "Bell's" was invented. This machine, which all authorities, nearly, agree in looking upon as the matrix or basis of the best-known reaping-machines, has been so often and so clearly described, that we need not take up space in adding to the list of descriptions. The best report we have met with, both as to its construction and practical merits, is a paper by Mr. Slight, presented to the Highland and Agricultural Society of Scotland, and printed in No. 35, New Series, of the "Journal of Agriculture." The best, and indeed the only correct and full account of the history of the invention, and its claims to originality, and to being considered as the basis of the American Reapers, is to be found in a paper written by Mr. Bell, the inventor, in the "Journal of Agriculture," No. 43, New Series, January 1854. This paper abounds with much that is valuable and practical, and is interesting as a delightfully-written account of the difficulties which beset inventors at the outset of their discoveries, and the final success generally attendant upon persevering efforts at amendment.

We have already adverted to the way in which Dobbs's reaping-machine was introduced to the public notice. Not so public, yet in way and manner quite as novel, was the first trial of Bell's Reaper. The following abridged account of this trial will no doubt be interesting to our readers:—"Let him" (the reader), says Mr. Bell in the paper above alluded to, "imagine an empty outhouse, rather long and narrow, having in one end a wright's bench, and in the other a rude-looking piece of mechanism—an embryo reaping-machine. For my subsequent operation, I chose a quiet day—that is, a day when there were few people about the place. On that day, an eaves-dropper might have seen me busily, but stealthily, engaged in conveying earth in a common wheelbarrow into the workshop. When the floor between the bench and the rude but ambitious candidate for the honours of the harvest-field was covered to the depth of some six inches, I proceeded to compress the loose mould with my feet. I next went to an old stack that happened to be in the barn-yard, and drawing a sheaf of oats out of it, and carrying it to the workshop, I planted it stalk by stalk at about the same thickness which I knew it should have grown in the field. This done, I shut and barred the door; and then going behind the machine, I pushed it forward with all my might through my planted oats. As soon as I recovered my breath, I anxiously examined how the work had been done. I found that it had been all very well cut; but it was lying higgledy-piggledy, in such a mess as would have utterly disgraced me in the harvest-field." After detailing how he succeeded in obviating the disadvantages of the machine, so as to render it a *reaping* and not a *cutting* machine merely, by attaching the canvass to pitch chains in place of ropes, he thus proceeds:—"The wheelbarrow was again in requisition, and another visit made to the old stack in the barn-yard, and the process of dibbling another sheaf gone through. The door was again shut, and, palpitating with expectation, I pushed the machine forward. To my unspeakable satisfaction, the oats were not only nicely cut, but were lying almost unanimously by the side of the machine, in one even, continuous row, as I had confidently expected." But all the difficulties had not vanished: what was found to act in a quiet barn, might not act in the varying experiences and conditions of an actual harvest-field; the experiments in the laboratory or workshop might be practically useless in "the actual domain of nature or of art." Thus cogitated the inventor; and having noticed that some of the stalks of oats had "straggled away capriciously" from the action of the cutters, he bethought him of the likelihood there was that the number of the stragglers might be multiplied greatly by the action of the wind on a breezy harvest-day, and finally introduced the admirable contrivance of the revolving reel or collector. The harvest season again came round, and with it the period that was to decide the merits of the machine. "That night," says the inventor, "I never shall forget. Before the corn was perfectly ripe (I had not patience to wait for that), my brother, now farmer of Inchmichael, Carse of Gowrie, and I, resolved to have a quiet and unobserved start by ourselves. That could not be got while the sun was in the heavens, nor for a considerable time after he was set, and accordingly, about 11 o'clock at night, in a darkish autumn evening, when every man, woman, and child were in their beds, the machine was quietly taken from its quarters, and the good horse Jack was yoked to it, and we two wended our way across a field of lea to one of standing wheat beyond it—my brother and I speaking meanwhile to one another in whispers." The first result obtained was far from satisfactory. "We were both downcast," continues the inventor; "but, recollecting myself, I had yet great hope, and said so, the whole of our machine not being used, the reel or collector having been left behind. I ran across the field, and brought the reel and everything connected with it upon my shoulders, and adjusted it as well as the darkness of the night would permit, and we were soon ready for a second start." This was successful. "The wheat was lying by the side of the machine as prettily as any that has ever been cut by it since." This was in the harvest of 1828. We may have to return to this interesting paper for the elucidation of some points connected with the history of the reaping-machine.

It has been generally understood that up to a period somewhat after the date of introduction of Mr. Bell's reaper, no machine of this nature was brought out in America. This, however, is not the case: so early as 1823—three years before the date of Mr. Bell's—a patent was taken out in the United States by Jeremiah Bailey, of Chester County, United States. A brief description of this early form of American reaping-machine may be interesting.

ON THE EMPLOYMENT OF PEAT IN BURNING CLAY PIPES OR TILES

By Henry Anderson, Jun., of Ballynacree, Ballymoney, Co. Antrim.

The importance of thorough draining has been for many years so fully appreciated, and the remunerative results have proved so very satisfactory to the agriculturist, that in the present progressive age, whilst foreign grain, both raw and manufactured, is admitted into our ports free from all duty, no land can be farmed with profit unless a liberal expenditure has been afforded it in drainage; hence we all feel the necessity of being able to accomplish this in the cheapest and best manner. Feeling satisfied that, even in districts where stones are abundant, tile-draining can be performed cheaper and in a superior manner if pipes or tiles can be obtained at a moderate rate, I now propose to state some results which may induce and enable interested parties to manufacture draining tiles or pipes in districts far removed from coal, where peat forms the local fuel.

My observation and experience in the use of this particular fuel have extended over a period of six or seven years, during which time I have seen several millions of pipes and tiles of all sizes burned, besides large quantities of brick; and, with the exception of one year, peat alone was used. About seven years since, my father having purchased a property in the north of Ireland (County Antrim), soon discovered that, although the soil was of superior quality, little prospect could be entertained of obtaining even a very moderate return for the amount expended in purchase-money, unless every acre was subjected to the operation of thorough drainage; he, therefore, immediately set to work, and as there was no tile manufactory in the district, stones were necessarily substituted; but as they had not only to be purchased, but also carted three miles, the expense was found so enormous as to preclude all hope of adequate remuneration. After minute inquiry regarding the cost of tiles in Scotland, as also careful calculations of the expense which their importation must incur, it became evident that draining could not possibly be effected under such disadvantages without a ruinous loss, whilst, were the land permitted to remain in its primitive condition, only medium crops could be expected. Under these circumstances, my father, being naturally desirous of obtaining reasonable interest for the considerable sum invested, and also anxious to set an example of improvement in agricultural matters (greatly needed in this neglected neighbourhood), resolved to attempt the manufacture of tiles on his own property, having observed clay which he believed suitable for this purpose in the stone drains then in progress of sinking. A portion of this clay was at once sent to a tile manufactory in Scotland, which being soon returned in the form of excellent draining tiles, with a most satisfactory opinion of its capabilities from the burner, ere many weeks had elapsed a moderately-sized work was erected, under the management of an experienced man from Scotland, who had spent nearly thirty years of his life in that occupation.

Since that period the works have been gradually augmented, proving in every respect most beneficial. Not only has nearly all the property on which they stand been drained, but a considerable quantity of tiles has been disposed of to neighbouring proprietors.

The superintendent, never having used turf for tile-burning, could not believe it suited for that purpose, and during the first year that the works were in operation coal was imported from Scotland at considerable expense; but having been at length induced to try the native fuel, he ultimately professed a preference for it, and all who have tested or seen the pipes or tiles produced under this system of burning admit them to be of superior quality. Feeling considerable interest in all matters connected with agriculture, since the erection of the works above mentioned I have directed my constant attention towards the entire process of manufacturing and burning tiles, as also the effects produced by different kinds of fuel; consequently, I state nothing which does not result from personal observation.

The quality of peat naturally varies considerably in almost every district; but for the general understanding and determining those varieties best suited for fuel, suffice it to say, that in bogs hitherto undisturbed, where this vegetable deposit is yearly accumulating, the uppermost portion generally consists of that description usually termed "flow," which varies in depth from 1 to 10 feet in different localities, and presents a soft, spongy, porous appearance; and on further examination it is found light, containing but a small quantity of matter capable of generating caloric, being, from its open nature, unable to sustain continued combustion. On the removal of this flow, a substance much closer and denser becomes visible; the increase of density arising, no doubt, from the greater length of time the deposit had existed, as well as the pressure caused by the superincumbent weight. When this variety of bog is carefully cut, dried, and especially if built into stacks, and allowed thus to remain for some months until entirely free from moisture, it forms a turf of sound quality, producing a good flame, and yielding a large amount of heat. The ash of this peat, as also that of flow, is light and white. The third and lowest deposit of a turf-moss is still closer and denser, approaching much nearer coal, becoming hard, black, and weighty, when prepared for use in the manner above described, affording also a greater degree of heat; consequently, it is preferred to either of the two former kinds by parties conversant with the relative value of turf. The ash remaining from this species is red, arising from its closer proximity to the clay.

In Ireland the use of turf as fuel is not confined to any particular district, its value being fully appreciated by most of the country manufacturers, who render it available in most of their public works, as also in the economy of domestic life; whilst to the poorer classes it proves a boon of no common magnitude, as during the process of preparation extensive employment is afforded them at a season when farming operations are light, whilst to all a cheap and cheering fire is secured during the cold and dreary nights of winter.

The most suitable method of using turf in the manufacture of tiles can briefly be stated, when it will be evident that in no degree does it differ from coal. At the commencement, the fire must be applied slowly, until whatever moisture yet remaining in the pipes has passed off, which is easily ascertained by observing when the steam ceases to escape from the kiln, which may be from twenty to thirty hours, according to the degree of dryness in which the pipes were when put into the kiln; after this the fuel is added more freely, increasing the quantity at each firing in proportion to the amount of heat required to burn the clay thoroughly. Some varieties of clay require more, some less; but this must be left to the judgment of the burner, who, it is supposed, understands the nature of the clay he is manufacturing. Care and close observation is very requisite, lest the heat may be too great or increased too rapidly, when melting would take place, as I have seen on one or two occasions. To attend the furnace of a large kiln where turf is the fuel, more assistance is necessary than when coal alone is used, as the rapidity with which turf is consumed in so hot a furnace as that of a tile-kiln causes the fires to require replenishing every twenty minutes or half-hour. The time occupied in the operation, from its commencement to completion, is from fifty to sixty hours—sometimes three days; nor would I recommend too great haste in burning off a kiln, having seen a tougher and nicer article produced by allowing the fires a little extra time, the uppermost row being as well burned as those in more immediate contact with the fire.

As the relative cost of turf and coal must necessarily depend on various local circumstances—such as distance, mode of conveyance, value of the article, where produced, &c. &c.—each individual must, of course, enter into these calculations for himself; but it may not prove uninteresting to give a brief statement of the difference in cost which exists in this district. Let us assume, then, that coals can be delivered at the works here, after paying freight and charges, land-carriage, &c., at 13*s.* per ton, either from the ports of Glasgow or Ardrossan, and the amount requisite for burning 25,000 2-inch pipes is 7 tons, thus costing £4 11*s.* 8*d.* per kiln, or 3*s.* 8*d.* per 1,000; while turf can be purchased at 6*d.* per gauge (a measure of three feet square), and 120 gauges, or £3 worth, are required to burn a kiln of equal size, thus showing a saving in favour of turf of 30*s.*, or upwards, on every 25,000 pipes, and nearly 1*s.* 3*d.* on every 1,000 pipes, which, in an article of large consumption and small value, is well worthy of consideration—to which may be added the facility of obtaining a ready supply of the fuel; whereas, early in spring, it is both inconvenient and difficult to import coals from Scotland, and at that season freights are higher, further adding to the cost of coals.*

As any kiln constructed for coal fuel will be found equally suitable for the use of turf, a few words on the subject of kilns best suited for turf will suffice. The first kiln erected at our works is capable of containing 25,000 2-inch pipes, and is similar to those used in the midland shires of Scotland, from which locality the plans were procured. As the works increased, another kiln was built, capable of holding 20,000, and which exactly resembles the common riddle kiln of Scotland, with this slight difference—the furnace bars extend wholly across the kiln, instead of

* If so large a saving can be effected where coals cost only 13*s.* per ton, it must be evident that the use of turf must be highly advantageous in the west and midland districts of Ireland, where coals are now very expensive.—Ed.

being, as is usually the case, only two feet in length; and trivial as this alteration may appear, most beneficial effects have been produced, greatly facilitating the process of burning, as the enlarged space thus afforded for the entrance of air materially increases and equalises the draught, and thus prevents the turf from becoming coated with ash, which invariably retards the process of burning.

The two fuels may, however, be used conjointly with beneficial results. Indeed, the burner here would be disposed to fire his kiln with coals for the last three or four hours, provided they were as cheap as turf; but my own opinion is, that this desire on his part arises wholly from a wish to save himself some of the extra labour and strict attention which is necessary when turf is used.

In my anxiety to compress the preceding observations regarding the use of turf as fuel into a brief space, I have not referred to the many other cases where it supplies the place of coal, but may state that it is used for economy in firing the ten-horse-power steam-engine erected on this farm for thrashing, oat-bruising, straw-cutting, &c. &c.

In conclusion, I have only further to remark, that it will be to me a source of sincere gratification if the information I have attempted to convey should prove the means of inducing landed proprietors (residing in districts where turf is abundant) to erect tile manufactories, which hitherto they may have been deterred from attempting in consequence of the absence or high price of coal.—*Prize Essay in Transactions of the Highland and Agricultural Society of Scotland.*

CORRESPONDENCE.

To the Editor of The Artizan.

Sir,—In the correspondence relating to the employment of vulcanised India-rubber for piston-packing contained in your two last Numbers, as well as in your own sensible remarks upon the complaints made regarding the inefficiency of this compound, one point seems to have been overlooked, which we should like to explain. During our early experience in manufacturing vulcanised India-rubber in the United States, we received frequent complaints of its failure whenever it came in contact with oil or grease, the same which Mr. Pinchbeck describes as the result of his experiments. In looking about for the cause of this, we came to the conclusion that it was to be attributed, not to the process of vulcanisation, which introduces no oil-attracting ingredients, *but to the preparation of the natural gum preparatory to that process*; or, in other words, to the solution of the gum in naphtha, between which and all oleaginous substances there exists great affinity. Where naphtha or an equivalent is used, the presence of which can always be detected by the strong odour, we have found it impossible, especially where very elastic packing was required, to vulcanise caoutchouc so as to resist oils. Fibrous packing—that is, India-rubber and cotton wool ground and mixed, and then vulcanised—was all that ever approximately answered the purpose.

Where naphtha is not used, however—where all volatile substances are dispensed with in the preparatory process, and the natural gum is simply torn to pieces in water (*chewed up*, in workmen's parlance)—the vulcanised India-rubber and oil have no affinity for each other, and a perfect piston-packing is produced. The same is true of vulcanised India-rubber steam-hose, suction-hose, machine-straps, &c., upon which oil, whether hot or cold, has no destructive effect whatever.

We are, your obedient servants,
Dodge, Bacon, and Co.

London, 22, *Coleman-street, Feb.* 13*th*, 1855.

To the Editor of The Artizan.

Sir,—I have not the least doubt that your tube-making Correspondent, *calling himself a Brassfounder*, would be delighted to find that his account of "Muntz's metal" was a correct one; but, unfortunately for him and his friend Mr. Armstrong, they are both completely at sea upon the subject, for the metal they speak of is not "Muntz's metal," but an imperfect and less valuable imitation, made of *anything by everybody*; and the theory given as to the cause of such metal failing is entirely wrong, as time has shown in sheathing and bolts, and will also do so in tubes, which are already proved too good for your Correspondent.

I am, Sir, yours respectfully,
G. Z. Muntz, Jun.

The writer will feel obliged to the Editor of The Artizan if he will insert the above in his next Journal.

French Walls, Birmingham, 17*th February*, 1855.

INSTITUTION OF CIVIL ENGINEERS.

February 6, 1855.

James Simpson, Esq., President, in the Chair.

On the announcement of the additions to the Library, attention was specially directed to the presentation by the Architectural Publication Society of the three first parts of the "Architectural Dictionary"—a valuable work, calculated to be of great use to the profession, and worthy of general support;—and also to a collection of very valuable Reports, with illustrative plans, relative to the water-supply and other municipal arrangements of the City of Paris, &c. They were entitled, "Mémoire sur les Eaux de Paris;"—"Recherches Statistiques sur les Sources du Bassin de la Seine, par M. Belgrand;"—and "Rapport sur le Mode d'Assainissement des Villes, en Angleterre et en Ecosse, par M. Mille." These latter valuable documents were presented by the Préfet de la Seine, through M. Mille, and were transmitted by the Consul-General of France; and the special thanks of the Institution were unanimously voted for this mark of consideration.

On the Flow of Water through Pipes and Orifices.

By Mr. J. Leslie, M. Inst. C.E.

The author having been professionally called upon to report on a small scheme of water supply, in which it was proposed to lay down a pipe with an unusually small declivity, was induced to have a set of experiments made on the discharge of a new lead pipe of $2\frac{1}{2}$ inches diameter and 1,086 feet in length, with heads varying from $\frac{3}{16}$ths of an inch to 10 feet. This pipe was laid in a coil of about 70 feet in diameter, and was afterwards successively shortened into lengths of 540 feet, 270 feet, 100 feet, 25 feet, and 10 feet. Other experiments were also made with pipes of $1\frac{1}{4}$ inch and $1\frac{3}{4}$ inch diameter.

As much care as possible was taken to insure the escape of air; but the results were in some cases so anomalous as to induce the belief that complete success had not, in this respect, been always obtained.

The pipes were also carefully joined and soldered, and it was believed that, with one trivial exception, no internal obstruction had existed.

The observations, which were exceedingly numerous, were stated to have been made with much care by Mr. John Lamond, an assistant of the author; and these had been tabulated at great length, and were annexed to the paper.

The object of the author having been to institute a comparison between the deductions of hydraulicians and the results of direct experiment, he had adopted, as a standard of comparison, a formula which he believed to be due to Du Buat, and from that had calculated "the ratio of actual discharge to Du Buat's formula."

The formula employed was thus expressed:—

$$v = \frac{3000\sqrt{d}}{\sqrt{\frac{l}{h}}}$$

in which v was the velocity per minute, l the length of the pipe, increased by 50 diameters, and d the diameter of the pipe, all in feet.

For the discharge (D), in cubic feet per minute, this formula became

$$D = \frac{2356 \cdot 2\, d^{\frac{5}{2}}}{\sqrt{\frac{l}{h}}}$$

Adopting this formula, the following were a few of the results obtained from the pipe $2\frac{1}{2}$ inches diameter:—

Pipe $2\frac{1}{2}$ inches diameter, 1,086 long + 50 diameters = 1,096 feet.

Head.		Gradient.	Observed discharge, cubic feet per minute.	Ratio of actual discharge to Du Buat's formula.
Ft.	In.			
0	$0\frac{3}{16}$	1 in 70,256	·0444	·252
0	1	„ 13,152	·2048	·503
0	$1\frac{3}{4}$	„ 7,515	·241	·448
0	$2\frac{1}{2}$	„ 5,260	·4412	·684
0	$5\frac{1}{2}$	„ 2,391	·7407	·776
1	$5\frac{3}{8}$	„ 757	1·4634	·863
2	$9\frac{3}{8}$	„ 394	2·22	·945
4	$9\frac{1}{8}$	„ 230	3·	·975
7	$0\frac{1}{8}$	„ 156	3·53	·945
9	$11\frac{7}{8}$	„ 109	4·286	·961

(It was shown in the discussion, which was only commenced, that the formula relied upon by the author was not that of Du Buat, which when applied gave results more closely approximating to those of the experiments than were obtained by the formula employed in the construction of this table.)

Numerous experiments were also made on simple orifices—on short tubes placed sometimes vertically, and sometimes horizontally—and on vertical pipes, from which coefficients of discharge, greatly at variance with accepted data, had been deduced; but it was afterwards discovered that the apparent anomaly disappeared if the active head were measured by the difference of level between the surface of the water in the cistern and the point of exit from the pipe, or the difference of level of the water in the upper and the lower cisterns.

Observations on a large scale were also made on the pipes of the Edinburgh Water Company. The "Crawley pipe" was 15 inches in diameter and 44,400 feet long, with a differential head of 226 feet. The actual discharge was 255 cubic feet per minute; whereas, by the formula, it ought to have been 294 cubic feet per minute. This pipe was, however, thirty years old, and was known to be considerably reduced in diameter by incrustation.

The "Colinton pipe" was 16 inches diameter, 29,580 feet long, with a differential head of 420 feet. The mean of fifteen observations gave an actual discharge of 571 cubic feet per minute, whereas the formula required that the discharge should have been 575 cubic feet per minute. This pipe was only eight or nine years old.

A section of the same pipe, of 25,765 feet in length, with a differential head of 230 feet, yielded, on a mean of twenty-six observations, 440 cubic feet per minute; whereas the discharge by the formula should have been 457 cubic feet per minute.

Another section of the same pipe, 3,815 feet in length, with a differential head of 184 feet, yielded 1,215 feet per minute, instead of 1,063 expected from the formula; but a new iron pipe of $2\frac{1}{2}$ inches diameter and 1,150 feet long, with about 11 feet of fall, yielded about what was due by formula to a pipe of $2\frac{1}{4}$ inches diameter.

Observations were also made on the Dundee conduit, which was 2 feet broad, with rectangular sides and a bottom of smooth stone slabs, with the following results:—

Fall 1 in 1,000.

Depth.	Calculated discharge.	Actual discharge.	Actual average ascertained velocity.	Velocity by floats at surface.
Inches.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.
6	109·	110·09	110·09	128·5
7	134·	134·83	116·	129·7
8	160·	162·16	121·6	133·1
9	186·	184·61	123·	136·7
10	213·	214·28	128·6	138·1
11	240·3	240·	131·	140·
12	268·	266·6	133·3	146·7

The formula used in this instance might be thus expressed:—

$\frac{15}{16}\sqrt{\text{hyd. mean depth} + \text{fall in feet per mile}} = \text{velocity in miles per hour.}$

The discharges by the sluices of the dock-gates of Dundee and the lock-gates of the Monkland Canal were also ascertained and tabulated. (The mean of the first seven observations gave a coefficient for feet of 5·3, and of the next four observations, omitting one imperfect observation, of 5·25, which were consistent with the received formula.)

A few experiments were also undertaken with respect to the flow of water over notch-boards; and some investigations were made for the purpose of determining whether the theoretical addition of 50 diameters to the length of the pipe was practically correct.

The author's conclusions were, that while "Du Buat's" formula gave very accurate results at moderate rates of inclination, it gave a great deal more than the actual discharge with very low gradients, and very considerably less with steep gradients.

LIVERPOOL POLYTECHNIC INSTITUTE.

January 15, 1855.

On the Compasses of Iron Ships, and their Disturbances.

By Mr. John Gray.

After a few introductory remarks, in the course of which Mr. Gray alluded in eloquent terms to the importance and rapid improvement in navigation, particularly steam navigation by means of iron ships, he proceeded as follows:—

If the Omnipotent has been so gracious and bountiful to this land, in providing her with such mineral resources, and ingenuity for rendering those mineral resources available for such gigantic works, and when we see our merchants anxious to invest their millions in these iron walls, it behoves every one connected with their construction and navigation to devote his entire energy to the successful accomplishment of the great ends in view, that our country may look with pride upon her children, in having been able successfully to surmount difficulties supposed to be insurmountable.

One of these difficulties has been in association with an instrument on which I am about to speak—an instrument, not many years ago, that was made in the rudest manner even in our navy; and I may say, with confidence, that only since the introduction of iron ships has there been an evidence of the absolute necessity for an improvement in their construction, which has been most successfully accomplished.

In her Majesty's service there has been a variety of instruments tried that have had, and must have, an ephemeral existence, for nearly all that have been made are mere palliatives of an evil, which attack the effect without consideration of the cause.

In the construction of a compass there are three important elements; namely, indication, steadiness, and durability; and any man who will sacrifice one in the slightest degree for the other, is no better than the ignorant nostrum-vendor alluded to.

I stated in my introductory remarks that the paper I have the honour of reading before this Society was one of a practical character, and my motive for adopting such a course was simply this.

Entertaining as I do the highest opinion of the theory propounded by the Astronomer Royal, in which the greatest amount of research has been displayed, and which has been carried out practically by me for these last fourteen years, it would be a matter of supererogation to say much upon that portion of the subject; nor shall I say much upon Dr. Scoresby's views. With regard to the learned Doctor's *high and elevated thought, the mast-head compass*;—in some instances it has worked well, in others quite the contrary. It is my intention to leave that gentleman in the hands of the Astronomer Royal; trusting this night to prove to the world, that, with the necessary appliances, iron ships may be navigated with as much accuracy as anything afloat. This I will say, that I do not consider it exactly compatible with a philosopher to publish statements without a proper investigation, as that must have a tendency to produce an unfavourable impression upon the public mind, if that which is published is not true; and if it entertains a more lenient view, we must come to the conclusion that a morbid love for a particular branch of science, which he may fancy he is great in, has disturbed the proper balance of his usually sound judgment.

The Doctor publishes in his pamphlet, addressed to the 'Underwriters' Association,' in corroboration of his views, an extract from an American paper, that the *City of Philadelphia* steam-ship, unfortunately lost near Cape Race, was adjusted in the *Clyde*, and, likewise, at Liverpool. Such is not the fact: she was not adjusted in Liverpool.

I ask, is this fair, is it proper that a gentleman whose calling should stamp in golden characters of truth every word that he utters or publishes, should so much forget his position as to allow enthusiasm to obtain ascendency over sound judgment, and permit him to pass censure without having ascertained whether such censure upon the port of Liverpool is really merited?

Besides which, I must tell the reverend gentleman that he treads upon dangerous ground in other assertions he has advanced—one of which I quote. "In the case of the *Tayleur*, when he just heard of the catastrophe and read the evidence, he had stated to some friends at Torquay that he would venture to predict that she was built with her head to the north."

Here is the prediction of a "seer;" like many others when a positive fact cannot upset the assertion; she was lost, and the change in her magnetic character could not be established.

The *Great Britain* went on shore in Dundrum Bay, and, fortunately, she was not lost, or we should have had Scoresbys in the field innumerable. As it was, notwithstanding Captain Hoskins' report and Captain Claxton's, after they had taken the compasses on shore for the purpose of testing those on board, which were pronounced to be true (and which the course indicated as correctly as the arrow that strikes the heart of a target), yet there were hosts who lifted up their voices (including the Doctor) that she went on shore solely in consequence of the erroneous condition of her compasses.

I state before the whole world, after such unqualified contradiction from those so deeply concerned, that such a statement, let it emanate from whom it may, is nothing less than a species of mendacity.

I stated that the Doctor knew, from his own assertion, that the loss of the *Tayleur* was owing to her head being built to the north. It so happens for his own convenience—for he must be right—that when he discovers that she was built with her head to the N.E. (one-eighth part of the circle), that this position was just the one likely to produce the melancholy catastrophe. It would have been quite as convenient for this gentleman to have taken S. or S.W., for it matters little, according to this theory, whether it is the stem or stern. He must be right, like a prophetic Zadkiel, until facts elicit the absurdity of the deductions. Here is a fact: The *Nubia*, built by Mr. John Laird for the Peninsular and Oriental Company, was built in the same magnetic parallel, and no change has taken place since I adjusted her. So careful was the company to ascertain whether change of position, vibration, or other causes were likely to affect this ship, that I was sent for to Southampton to verify that which I had previously done. What was the result? I found everything perfect; in proof of which I received the following letter:—

13, Portland-street, Southampton, Dec. 15, 1854.

Mr. Gray, Liverpool.

Dear Sir,—I have great pleasure in bearing testimony, after the experience of two voyages to Alexandria, to the very effective manner in which the compasses of the Peninsular and Oriental Company's steam-ship *Nubia* were adjusted by you.

I entirely approve of the simple but effective plan adopted by you in the adjustment. The most critical observation could not detect a larger amount of error than you had allowed for local attraction. Indeed, so satisfied was I with the result, that I firmly believe that the plan practised by you is not only the most simple, but the least subject to error, of the numerous plans in use. I have not failed to recommend it to numerous naval people; and I feel certain, the more generally it is known, the more fully it will be adopted.

I am, dear Sir, faithfully yours,

Hy. Harris,

Captain H. C. S., late in command P. & O. Co.'s steam-ship *Nubia*.

Now, if we find that two vessels of large magnitude are both built in the same direction; both come to Liverpool, one from Warrington and the other from Birkenhead; are placed in the same dock, with their heads in the same position, and the results are prophetically dissimilar;—I say that such a theory is of an exaggerated character, the deductions are erroneous, and that other phenomena really exist. That the fluctuating or evanescent condition of the induced magnetism is of that character ascribed either with regard to the quickness of its operation, or its magnitude, I utterly deny; but, however great or small may be the intensity of the disturbance in the course of time (and, mark you, it is always upon the right side), it is slow in its action. The Astronomer Royal stated, in the Athenæum, that the Doctor's allusion was a most unfortunate one with regard to the *Tayleur;* that he did not believe any such error existed in so short a period; and that it was also quite contrary to any known law in connexion with the theory of magnetism. I believe what he stated was strictly true. I am sure he was correct in his views; but, as we have a right to give every man the benefit of a doubt when other causes may have arisen, I carried out that principle in my evidence before the Local Marine Board, and stated that I would not declare an error did not arise, as a variety of circumstances might have happened to produce a derangement of the compasses: but, as far as the phenomena are concerned in association with iron craft, particularly in sailing vessels, that such an amount of error as was stated really existed I emphatically deny. I declare, most solemnly, that, during the whole course of my experience, I never found an instance, nor do I believe that any positive evidence will, or ever can be, brought forward, of a similar character as long as an iron ship is afloat!

The disturbance of the compasses on the side of the equator is exceedingly conflicting in its character: sometimes ships undergo no alteration whatever—for instance, the *Sarah Sands,* and many more; but from the report of others we hear of considerable derangement: hence a strong fact is elicited, that the theory propounded by Dr. Scoresby and his disciples is not universal; for every man that is conversant, practically, with the deviation in iron craft, must know that it is dissimilar in its character, ranging from 5 degrees up to 70 in the original amount of error, and the fluctuations, in its changeable condition, amounting in one or two instances, in screws, to nearly 17 degrees; and in some cases, where you would expect the greatest amount of deviation, either in permanent or sub-permanent magnetism, there you will find the least.

One vessel which I adjusted, built by Mr. James Hodgson, had an iron hull, an iron deck, iron bulwarks, and iron funnel, which was converted into a mizen-mast; and its proximity to the binnacle was such that I dreaded the time when my services were required.

What was the result? She was perfect in all the cardinal points; and the only deviation which absolutely existed was upon the intermediate, that merely required a mass of soft impolarised iron to correct that disturbance. So much for accident. If a duplicate ship were made in the self-same manner, in the self-same position, and everything adhered to (as far as human ingenuity is concerned) implicitly in the self-same construction, I would risk my life and everything that I possess, that the same phenomena would not exist in both.

I am exceedingly sorry that I have been compelled to express myself so strongly upon the views of that venerable gentleman, Dr. Scoresby; but however great may be my veneration, where a principle is at stake, I should ill become the position which I occupy if I allowed the learned Doctor to promulgate that which is not correct without contradiction. When his remarks have destroyed confidence with numbers, on a material not only beneficial to the port of Liverpool, but every place in her Majesty's dominions, as long as I live, and am in any way identified with the adjustment of iron craft, I should consider myself unworthy of the position I hold if I allowed any one to publish that which is not correct, and which also has a tendency to tarnish the lustre of a *great man's greatness,* whose mental power has grasped the entire question. "Render unto Cæsar that which is Cæsar's," is not only the doctrine which the reverend gentleman propounds in his own pulpit, but is a universal moral law. Let any man read the Philosophical Transactions for 1839, he will there find that that portion of induced magnetism, which the Astronomer Royal has since called (and very properly) sub-permanent polar magnetism, was dealt with by him perfectly; therefore the only difference is in its amount and changeability. To prevent this being a bugbear "to fright the Isle from its propriety," I have adopted a different system to the Doctor; for I have invented an apparatus capable of dealing with any difficulty, imaginary or real. The Astronomer Royal thought of the same thing at the same time, and when my communication was made to him, he stated that he had prepared a model for the same object, and the only difference existing really between us was in a matter of detail, in which my plan was more universal than his, being calculated for any situation; but, like a noble-minded man, he wrote to me that he would not support his views in opposition to my practical experience.

As I consider it my province to be more in the character of a demonstrator than a theorist, and whether Dr. Scoresby's remarks have made a powerful impression upon your minds, in causing you to be sceptical as to the application of magnets on board iron ships, or not, I will endeavour to convince all, that, however great the deviation of the compass may be, it will be perfectly within control of the captain. I state emphatically, that he is not worthy of the command, if he cannot comprehend fully and practically the entire process during the operation of swinging and adjusting the vessel; and if he do this, whatever latitude he may be in, whether it be north or south, and whatever may be the amount of deviation, let it be either degrees or points, he will be able to adjust his compasses nearly as easily as winding up his chronometer.

Here is a compass (showing one) which was used in the navy and mercantile marine generally, when these instruments were contracted for, like common slops, almost for the lowest tender. What was the effect? There was no premium, like that which was given for chronometers, for the most perfect instrument; but the veriest rubbish was introduced into the service, and allowed to go on until iron ships brought the Government to a partial sense of the necessity for an improvement. A manufactory was established under the auspices of the late Captain Johnson; and I state, fearlessly, that nothing has emanated from that centralised factory calculated to meet the exigency of the times.

Now, let me caution the shipbuilders and shipowners of this nation against fostering any system of an illiberal character; for where mind is at issue, it cannot be fettered, but will rise with indignation against a slavish principle; and if thwarted, curbed, and confined within the trammels of ignorant officials, it sinks into apathy, and the State loses its sinews and its strength. Feebleness becomes the offspring, and the country has to pay for the weakness it has created.

In the great variety of instruments which have been made, one of them possessed only one quality, and that was the novelty of its idea.

This invention was of a peculiar kind. Mr. Dent, the inventor or patentee, entertained the opinion that to correct the oscillatory action of the card, all that was necessary was to make the centres of action two pivots, like the staff of the balance of a chronometer (of which he was a professed maker). What was the result? Notwithstanding the prestige of a most unparalleled character, which obtained for him trial after trial in her Majesty's yacht the *Fairy,* this very compass was pronounced to be worthless; whilst my own, without this latter improvement, was considered perfect, which a letter and subsequent order from the Lords of the Admiralty will testify.

With this instrument, there is one feature which stamps it with absurdity—the supposition that a compass must be always upright. Now, sir, with a vessel tossing and tumbling about upon the ocean, this is an impossibility; for the very instant that the slightest deviation from the perpendicular is created, that very instant does oscillation commence, the specific gravity of the needle preponderating over its magnetic power. The amount of oscillation is in proportion to the angle it describes; but to remedy this, which could not have been thought of previously, what was done? A lever was applied for the purpose of producing additional friction, at the loss of indication, and that to a serious extent.

Sir Snow Harris invented a compass, which was very beautifully and scientifically constructed, to reduce the number of oscillations by the introduction of a metal ring. That it does so I will not deny; but it is deficient in counteracting the effect of vibratory action, and has been found useless in steam-vessels which have come under by observation.

In iron ships, the amount of deviation varies from about 5 degrees to 70; and when the larger amount prevails, the rapidity of the change from its maximum to its minimum renders it not only a difficult, but a dangerous process, to give what is termed a card of deviation, whether it is recorded in degrees, or an artificial card is adopted where the points of the maximum errors have to be extended, and the minimum crowded together.

Ask any practical seaman whether, under such circumstances, any man can steer a true course. I distinctly say, the bare supposition is absurd. It has been tried and failed scores of times, and the old system adopted.

Oscillatory action from the screws is another element which renders the seaman's life one of anxious care; and, do what you will, a slight amount of error will exist as long as a steamer is afloat. Where it exists to excess, the number of oscillations are irregular; consequently, the cause is enormous. There is another peculiarity incidental to the screw, however accurately the compasses are adjusted. They nearly all go starboard; hence arises the necessity for giving the Irish land a wide berth in going down Channel, and the reverse in coming up. Another source of deviation arises from currents, not only in the ocean, but likewise in the Channel; not proceeding from known and acknowledged laws, but arising from that which the sailor can never know—the extent of a repetition of gales in one direction. These phenomena, sometimes acting in conjunction, produce an amount of deviation often charged to the poor compass. But I hope to see the day when the incubus of public hypothesis will no longer exist, and that the apparatus I have invented will be the pioneer to its accomplishment.

With this apparatus, all that is required, is an observation by night or day, either by the pole star or meridian altitude in the northern region, or the southern cross and altitude in the southern; two positions are merely required, and the adjustment for heeling can be effected when under a press of canvas.

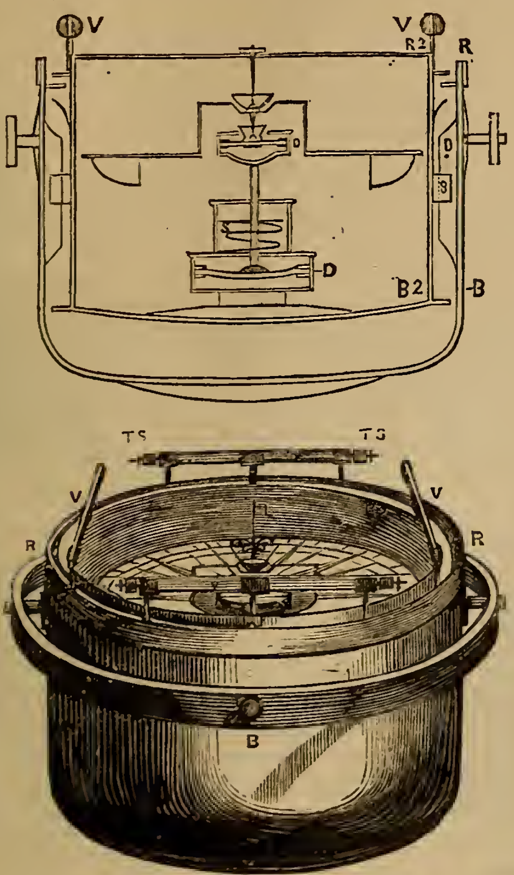
The extraordinary phenomena of magnetism and its spontaneous inductive power strike us with wonder—strike us with consciousness that God in his infinite mercy has made this element a vehicle for scattering blessings incalculable over the entire universe—the disseminator of truths to the wild aborigines of the most distant climes—a vehicle for substituting civilisation for barbarism, and gentle love for savage butchery—the comforts, elegancies, and refinements of society carried into the very heart of solitudes, where nought was heard save the piercing shriek of the cannibal's victim, or the mocking laugh of the fierce hyena.

Inductive magnetism is not only that which spontaneously diffuses itself through all iron bodies, but can likewise instantaneously be given by artificial means. In iron ships, that portion which it imbibes I have found to be of a very permanent character, with some exceptions; but, as I expressed before, the phenomena is not universal.

That portion which is changeable, the Astronomer Royal has properly called sub-permanent polar magnetism; but when a change in this property does take place, it is not sudden in its operation, but generally gives the mariner notice to keep a sharp look-out, acting salutarily in the prevention of blind confidence.

But there is one feature in iron craft very satisfactory: the original amount of deviation decreases with years, and they settle down, like good sober citizens of the world, to perform their duty. Let us perform ours. I will endeavour, to the best of my ability, to give a code of simple instructions to the mariner which will enable him to have a perfect command over the instrument, so that life and property may be preserved as far as human skill can accomplish.

Look ofttimes at the sailor's forlorn condition—tossed, tumbled, buffeted, on the ocean. When hourly expectation eagerly dilates the eye with fancied joy in meeting those he deeply cherishes; when a mistaken course, a blundering helmsman, drives a noble ship on shore, and those beings, glad with hope, steadfast in duty, in one moment are placed within the jaws of death, never to return to their domestic hearths;—when such facts are known and felt by all practically and scientifically engaged, let us unite our efforts in establishing that which is good; and when all is done that man can effect to overcome the power of a ruthless and treacherous ocean, teach him to appeal to that source from which all hope is given, and ever feel the force of that holy motto, "*Domine dirige nos.*"



DESCRIPTION OF GRAY'S PATENT FLOATING COMPASS.

B.—Outer bowl, containing fluid in which
B2.—Inner bowl is floated.
R.—Rim of outer bowl.
R2.—Rim of inner bowl.
V.—Vulcanised India-rubber, or other springs to keep the inner bowl (B2) in central position within the outer bowl (B).
T.S.—Tangential screws to adjust and bring the inner bowl (B2) exactly into the centre of the outer bowl (B).
D.—Guides to prevent any rotatory motion, which the inner bowl might otherwise be subject to; also to keep the Lubber's point exactly fair, or parallel with the ship's keel.
L.—Lubber's point.
D.—Elastic discs.
S.—Spiral spring.
S.—Guide on inner bowl.

IMPROVEMENTS IN ACCOUNT-BOOKS.

Messrs. Waterlow and Sons have become the proprietors of a patent for "Improved Hinge Binding."

The improvement consists in the substitution of a metal hinge for fastening the inside of the book to its covers, in place of the ordinary linen joints, which have been found so frequently to give way before the book is done with. By this method, the inside of the book is entirely independent of the covers, and may be separated from them with the greatest ease by the removal of a sliding pin, so that one cover may be made to answer for several books, or new covers may be supplied to an old book without the necessity of the book itself being placed in the hands of a binder.

All of our friends who have had any clerical experience will have been annoyed by the awkwardness of writing where the pages meet at the back of the account-book, owing to their opening *round*. In the specimen before us this difficulty is obviated; for the metal hinges will support the back of the book, and, by the great freedom with which they work, throw it well open, and present, at all times, a perfectly flat, smooth surface to write upon.

CORNISH STEAM-ENGINES.

Abstract from "Browne's Cornish Engine Reporter," from 20th December to 20th January:—

PUMPING ENGINES.		
Number reported		24
Average load per square inch on the piston, in lbs.		15·7
Average number of strokes per minute		5·0
Gallons of water drawn per minute		4,499
Average duty of 15 engines, being million lbs. lifted 1 ft. high by the consumption of 1 cwt. of coals		70·1
Actual horse-power employed per minute		998·0
Average consumption of coals per horse-power per hour, in lbs.		3·4
ROTARY ENGINES.—WHIMS.		
Number reported		17
Number of kibbles drawn		38,331
Average depth of drawing in fms.		131·3
Average number of horse-whim kibbles drawn the average depth by consuming 1 cwt. of coals		51·0
Average duty of 12 engines, as above		16·1
STAMPS.		
Number reported		5
Average number of strokes per minute		9·0
Average duty of three engines, as above		51·7
Actual horse-power employed per minute		108·0
PUMPING ENGINES DOING HIGHEST DUTY.		
Fowey Consols, 80 in. single	Millions.	101·5
Par Consols, 80 in. single	,,	100·5
Great Polgooth, 80 in. single	,,	91·3
Pembroke and East Crinnis, 80 in. single	,,	78·6
Pembroke and East Crinnis, 70 in. single	,,	76·8
Par Consols, 72 and 36 in. Sims' combined	,,	76·6
West Fowey Consols, 60 in. single	,,	74·7
Trelawny, 50 in. single	,,	70·8
WHIM ENGINES.		
Fowey Consols, 22 in. double	Millions.	26·7
Par Consols, 24 and 13 in. Sims' combined	,,	19·5
Par Consols, 24 in. single	,,	19·2
Great Polgooth, 22 in. double	,,	18·0
South Caradon, 30 and 16 in. Sims' combined	,,	16·4
STAMPING ENGINES.		
Wheal Uny, 36 in. single	Millions.	56·7
Great Polgooth, 35 in. double	,,	52·1
South Caradon, 26 in. single	,,	46·2

NOTES AND NOVELTIES.

*Chadwick's Machine for Reeling Silk from the Cocoons.**—That the idea of importing the cocoons themselves instead of the raw silk has already begun to be entertained by the silk manufacturers of England, is proved by the fact of a patent having been already taken out there for a machine for reeling the silk from the cocoons. This machine, invented by Mr. John Chadwick, a silk manufacturer of Manchester, described in a recent number of The Artizan, and which we believe is in actual operation, is incontestably inferior to the one of Alcan and Limet, which is equally applicable to the cocoons of any species of silkworm. Mr. Chadwick's machine possesses some advantages, which, if added to the French one, would render it so perfect as to solve at once the practicability of importing cocoons on a great scale.

Mr. Chadwick's machine "consists of an iron framework about four feet wide, four feet high, and four yards long. On each side there is a row of 30 bobbins arranged vertically, about 18 inches from the floor. They are furnished with ordinary flyers for encircling them with the thread as it is produced; and to each of the sixty bobbins there is a motion by which each can be thrown out of gear independently of the other. Over the bobbins there are on either side 30 copper troughs or basins, containing water at a temperature of about 120 degrees. In each of these troughs float six cocoons, and the silk from these 360 cocoons is drawn by very simple means. The continuous filament does not lie in circles upon the cocoon, but describes a form very similar to the figure 8 placed on the surface in a longitudinal direction, thus ∞. As the filament is drawn off, the cocoons have a slight oscillatory motion in the water; and to keep them from entangling one another, the basins are provided with brass wires of proper shape, a little above the surface of the water. Nearly a foot above each basin there projects a wire about three inches long, covered with some soft woollen or other substance; and over this material each set of six filaments are drawn, the effect being to cleanse them from superfluous moisture, and from any impurities which may adhere to the slender thread. To effect this object, the throwster (in a second stage) resorts to a special winding, the thread being drawn through a groove. Since, however, it is then in a dry state, the slight impurities are not likely to be so easily removed from the fragile filament as when it is moist. After descending from the cleansing part, the six filaments pass through a small curve made of glass, and are received by the flyers and spun upon the revolving bobbins. By this treatment, the winding into hanks as performed by the silk-growers abroad, the winding on bobbins from the hank, and also the cleansing process, as heretofore performed in England by the throwster, are entirely dispensed with; a perfect thread of silk twisted or spun being furnished at one operation; so that if the silk be intended for organzine or warp, it only requires the further process of doubling and throwing; but if for tram silk, one process is sufficient, as thread can be easily varied in thickness, by simply increasing or decreasing the number of cocoons placed in the basin."

* From the "Journal of Industrial Progress."

"One young girl can easily superintend 30 troughs, and a continuous thread can be produced to fill a bobbin, free from knots or piecings; for as any single filament breaks, the new end has simply to be placed in contact with the other five, and becomes one with the thread; and as the cocoons end at different places, the whole is produced in the same number of fibres. A bobbin of China silk was inspected of double the fineness of any China silk imported, equal to the finest French thrown silk, and calculated to be worth more by 8s. or 10s. per pound than the same kind of silk would have been if reeled from the cocoons in China."

Previous to reeling, the cocoons undergo a certain preparation: "They are placed for a few minutes in a solution of soap and hot water. By means of a perforated ladle, they are then removed to an adjoining trough of warm water; and here, with surprising facility, the principal end of the silk on each cocoon is found by the hand of the girl who discharges that duty. The water detaches the end, and she catches it from the floating surface, sometimes taking up half-a-dozen such ends of silk at a time. A little is drawn off, and then these cocoons are placed in a basin, the ends hanging over the side. The two girls who superintend the reeling fetch them as they may be required, and place them in a trough at the end of the reeling frame, from which they remove them to the respective basins, to substitute the cocoons as they become exhausted of silk. The apparatus strips the silk very perfectly—in fact, down to the thin covering which encloses the chrysalis. It is stated that four pounds weight of cocoons abroad or in France (where reeling has been performed for a few years with an instrument nearly the size of this for two sets of cocoons) will produce one pound of silk, but that by this process more than one pound weight is obtained. A new channel in the business will require to be opened—that of importing the cocoons. These have never been supplied, because they have never been demanded; but we suppose they would follow the usual law in this respect which rules other merchandise, and find their way to a good market."

It is further stated, that the silk made by this machine is of twice the fineness of the China silk which is usually imported, and that there is less refuse than by the hand process, or by another apparatus which has been in use for two years in France—meaning, we suppose, that of Messrs. Alcan and Limet. If this be the apparatus meant, we certainly doubt the correctness of the statement, as will every one who compares the processes. Mr. Chadwick, it appears, claims the entire ground of reeling the silk direct from the cocoons: he might as well have at once claimed the discovery of silk. The error of claiming too much in a patent is a mistake, and we are much surprised that the author of a really genuine improvement like that of Mr. Chadwick should commit such an error.

Rope and Cord Machinery.—Messrs. J. P. and E. T. Wright, of Birmingham, have patented improvements in scraping, sizeing, scouring, stripping, or polishing, and drying ropes, cords, lines, and twines, by machinery, instead of by hand. The unfinished ropes to be operated are wound upon bobbins. On the cord leaving the bobbins, it passes through an eye for guiding it; it then passes under a knife or scraper, over another knife, and again under a third knife, or scraper, whereby the loose fibres are removed from the rope. After passing from the last-named knife, or scraper, it passes through a box containing size. The box and knives, or scrapers, are fixed on a table, which rests on slides, on the framing of the machine. A reciprocating motion is given to the table upon the size-box, and knives are fixed by an eccentric and connecting rod, the eccentric being situated on the main shaft of the machine. While the cord is being slowly drawn through the machine, it is subjected to a scraping action by the alternating motion of the knives, and is impregnated with size by the size-box, through which it passes. The cord is next subjected to the action of two scourers: these scourers are situated on the top of two arms, which have a reciprocating motion given to them by connecting rods jointed to wheels, geared to the main shaft of the machine. The cord next passes through a fixed stripper, or polisher, situated on a table. The stripper or polisher consists of a piece of rope, coiled into a helical or corkscrew form, and gives a polish to the sized cord as it passes through it. The cord next passes through a stove or hot-air chamber; combustible gas is conveyed through a pipe to the tuyere or jet in the stove, and a stream of air is delivered into the tuyere by a pipe attached to a pair of bellows, which are actuated by a comb, situated upon an axis, worked by a band from the main shaft of the machine. After the cord has passed through the last-named hot-air chamber, it passes through a second one, exactly similar to the first-mentioned chamber. After leaving the second hot-air chamber, where the sized cord receives its final drying, it passes through a stripper or polisher, made of a helix of rope, by which it receives its final polish. This stripper or polisher is situated upon a table, which receives a slow, reciprocating, transverse motion (for the purpose of grinding the cord as it coils itself on a drum or terry on the end of the machine), by a band from the main shaft of the machine.

Pile-driving Machine.—Mr. Edward Trenery, of Stourbridge, has just patented a machine for driving piles, by which the hammer or ram is raised and disengaged from the raising mechanism in the following manner:—At the bottom of a chain, a rack is placed; the upper part of this chain is attached to a pulley which hangs in a loop in the chain carrying the hammer or ram. An axis, carrying a crank, has a pin or stud on its face, which pin, on the rotation of the axis carrying the crank, engages in the teeth of the rack and depresses it, and consequently raises the hammer or ram. When the crank has proceeded to its lowest point, the rack is disengaged from it by striking against a fixed stop on the frame of the machine, and the hammer or ram falls, and, in its descent, strikes and drives the pile. On a further rotating of the crank, it again engages in the teeth of the rack; and the motion described is repeated on each revolution of the axis carrying the crank.

New Locomotive Power.—In this neighbourhood an important experiment is about to be made in relation to the propulsion of carriages on surface and underground railways by atmospheric power. The application of this power to the object proposed is effected through the means of well-known machinery, differing little in construction from the ordinary steam-engine cylinder, and the whole arrangement has no other relation to bygone experiments than that arising from the power employed. Leakage, hitherto a principal source of failure in other atmospheric systems, is by the present arrangement effectually avoided. This important feature, and the extreme simplicity of the principle, establish this plan as being quite new, and entitle it to consideration, uninfluenced by all former unsatisfactory attempts to apply the same source of power. The peculiar applicability of this system to underground work is proved by the absence of smoke and steam, and particularly by its being a certain and economic means of ventilation—an undertaking at present a source of so much anxiety and expense to mineral proprietors.—*Swansea and Glamorgan Herald.*

DIMENSIONS OF STEAMERS.

PARTICULARS AND PERFORMANCE OF THE STEAMER "NORTH CAROLINA."

BY J. VAUGHAN MERRICK.

Hull built by Vaughan and Fisher, Philadelphia; machinery by Merrick and Sons, Philadelphia; owner, Alexander Heron, jun. Intended service, Philadelphia to Wilmington, North Carolina.

Hull—Single-decked, with poop-cabin.

Length for tonnage	172 ft.
Length on deck	176 ft.
„ deep load water-line...	170 ft.
Greatest breadth at deep load-line	33 ft. 4 in.
„ „ main wales	32 ft. 2 in.
Depth of hold...	12 ft. 4 in.
Length of engine and boiler-space	34 ft.
Draft of water at deep load-line	10 ft.
Tonnage, Custom-house ...	672
Area of immersed section at 9 ft. 3 in. mean draft ...	249 square ft.
Contents of bunkers in tons of coal	90

Masts and rig—three masts; foremast square-rigged; heavily sparred and canvassed.

Engine — one, vertical square. Diameter of cylinder, 56 inches; length of stroke, 4 feet; maximum pressure of steam in pounds, 25; cut-off, do., variable from $\frac{1}{3}$ to $\frac{3}{4}$; maximum revolutions per minute, 29 to 30 of engine; gearing, 1 to $2\frac{2}{3}$, giving $77\frac{1}{3}$ to 80 of propeller. Boilers—two, return tubular; length of boilers, 13 feet 3 inches; breadth of boilers, 9 feet 7 inches; height of boilers, exclusive of steam-drum, 10 feet; height of boilers, inclusive of steam-drum, 19 feet. Number of furnaces, in all, 8; breadth of furnaces, 1 foot 9 inches; length of grate-bars, 7 feet 3 inches; number of flues or tubes, in all, 324; internal diameter of flues or tubes, 3 inches; length of flues or tubes, 8 feet 3 inches; heating surface, in all, 3,010 square feet. Diameter of smoke-pipe, 4 feet 11 inches; height of smoke-pipe, 54 feet above grate; description of coal, anthracite; draft, natural; consumption of coal per hour, 1,500 lb., estimated. Propeller — true screw, of cast-iron; diameter, 9 feet 3 inches; length, 2 feet 9 inches; pitch, 16 feet 6 inches; number of blades, 3.

REMARKS.

This ship possesses the largest freighting capacity of any steam-ship of her tonnage in the U.S. Marine. She was modelled by Mr. John W. Griffiths, marine architect, and was intended for a freight-ship with very light draft. With 350 tons dead weight, in addition to her coal for six days' steaming, she will draw but 10 feet on an even keel.

The fore body rises from midship section, so that her real draft from base line, measured on the forward, perpendicular, is three feet less than by marks. She has full after-water lines and amidship section aft of the centre of length.

The engine is a vertical square condensing engine, having its cross-head overhead, and two side-rods attached to crank-pins in the driving spur-wheels, the crank-shaft being beneath the cylinder bottom. On the opposite side of the propeller-shaft is a tubular condenser; the main and fresh-water air-pumps, and other pumps, are outside of it, worked by boiler-plate side-levers attached by links to the cylinder cross-head. The valves are equilibrium poppets, with Allen and Wells' adjustable cut-off on steam side. The gearing is of iron, with shrouding to the pitch-line; wheels, 6 feet 4 inches diameter, and 2 feet $8\frac{1}{2}$ inches diameter of pinion; 10 inches face of teeth on each set.

On the trial-trip, the propeller was not nearly submerged, being 1 foot 7 inches out of water; draft aft, 8 feet 2 inches; draft forward, 7 feet 7 inches. Bunkers filled, but no freight in. The boilers made abundance of steam for 29 revolutions of the engine, while indicator cards showed an initial pressure in the cylinder of 25 to 26lb., cut-off at three feet, or $\frac{3}{4}$ stroke.

On the first trip of the ship, her performance down the river, as far as Newcastle, was noted, and is given below: owing to the floating ice in the river, the ship was not driven, a pressure of 21 pounds only being maintained in the boilers, cut-off at 18 inches, or three-eighths of the stroke only. From the speed then attained (10 miles per hour), it is probable that at least $11\frac{1}{2}$ miles per hour may be obtained with full *steam pressure*, in still water.

Performance on First Trip.—Draft of water aft, 10 feet; forward, 8 feet 6 inches; with 150 tons freight, beside 90 tons of coal in the bunks.

Passed.	Time.		Whole Distance.		Registered Rolevutions.		Revolutions per mile.		Steam.	Vacuum.	Cut-off in Inches.
	H's.	Running.	Apparent.	Actual.	Whole.	Nett.	Engine.	Propeller.			
Navy Yard......	10·20				477				14		18
Chester	12	1·40	16·50	17·00	2870	2393	140·8	375·4	20	26½	18
Marcus Hook...	12·55				3853				21		18
Newcastle	2·45	1·50	14·50	18·50	6600	2747	152·5	406·7	21	26½	18
Means.........							146·6	391·5			

The actual distance is known by applying a correction for tide, which was adverse, except for about four miles. The particulars from Chester to Marcus Hook are not noted, owing to time, &c., lost in landing a passenger.

The average revolutions per mile run by the ship were 391½ of the propeller, equal to its advance through 391½ × 16½ = 6,459 feet.

The slip was, therefore, 6,459 — 5,280 = 1,179 feet = 18¼ per cent. The average revolutions per minute, with 19 pounds steam, cutting off at three-eighths stroke, from Navy Yard to Chester, were 29·93; and with 21 pounds, at three-eighths stroke, from Marcus Hook to Newcastle, were 24·88.

The propeller-shaft has a slip-clutch, by which the propeller may be disengaged when the ship is under sail.

The engineer's department of this ship is provided with every convenience. A Worthington steam-pump is attached for putting out fires, washing decks, pumping bilge, or feeding boilers; it has an auxiliary steam-boiler on deck, by which it may be worked in port. The thrust-bearing of the shaft has Parry's anti-friction conical rollers, which worked well so far as heard from.

LIST OF PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 14th October, 1854.

2202. L. Monzani, Greybound-place, Old Kent-road—Bedsteads.

Dated 24th October, 1854.

2264. J. Adams, Massachusetts—Printing machinery.

Dated 10th November, 1854.

2389. E. W. K. Turner, 31, Praed-street, Paddington—Separating fluids from substances.

Dated 14th November, 1854.

2414. G. Bodley, Everhard-street East—Revolving cannon.

Dated 20th November, 1854.

2451. H. Draper, St. Michael's-terrace, Pimlico—New material for paper.

Dated 25th November, 1854.

2495. J. S. Holland, Woolwich—Fire-arms.

Dated 29th November, 1854.

2513. J. M. Hyde, Bristol—Iron steam-ships, their boilers and machinery.

Dated 30th November, 1854.

2519. J. Mason and L. Kaberry, Rochdale—Spinning machinery.

Dated 1st December, 1854.

2525. J. Whitworth, Manchester—Cannons, guns, and fire-arms.

Dated 12th December, 1854.

2611. R. Larkin, 2, St. John's villas, Highbury—Locks and keys.

Dated 19th December, 1854.

2671. W. P. Dreaper, Liverpool—Pianofortes.

Dated 21st December, 1854.

2695. A. Smith, Princes-street, and J. T. Mackenzie, Lombard-street—Application of high-pressure steam to ordnance and small arms.

Dated 23rd December, 1854.

2717. T. Heppleston, Manchester—Finishing machinery for silk, &c.
2719. W. De la Rue, Bunhill-row—Treating products from naphtha.

Dated 26th December, 1854.

2723. P. P. Blyth, 23, Upper Wimpole-street—Screw-propellers.

Dated 28th December, 1854.

2735. M. Williams, Chelsea—Suspending looking-glasses.
2737. P. Haworth, Manchester—Band-fastener.
2738. R. Threlfall and R. W. Pitfield, Bolton-le-Moors—Spinning machinery.
2739. J. Murdoch, 7, Staple-inn—Waterproofing woven fabrics. (A communication.)
2741. J. Gray, Liverpool—Adjusting ships' compasses.
2742. G. J. Bensen, 7, Christian-street—Refining sugar.
2743. H. C. Hill, Parker-street, Kingsland—Portable barracks.

Dated 29th December, 1854.

2744. J. Nasmyth, Barton-upon-Irwell—Forging masses of iron.
2745. P. Thompson and W. Wagstaff, 12, Pall-mall East—Photography.
2746. A. Dietz and J. G. Dunham, Raritan, New Jersey, U.S.—Reaping-machines.
2747. A. Stansfield and J. Greenwood, Todmorden—Power-looms.
2748. I. Z. Bell, Sandfield-place, Lewisham-road—Boots and shoes.
2749. H. Widnell, Lasswade—Carpets.
2750. E. Loysell, Paris—Injecting machine.
2751. T. Thorneycroft, Wolverhampton—Ship-building.
2752. J. Pillans, 40, Brompton-crescent—Preparation of bematosin and fibrinous and serous matters.
2753. H. R. and I. A. Fanshawe, North Woolwich—Waterproof garments.

Dated 30th December, 1854.

2755. R. Chapman, Manchester, and J. Miller, Stalybridge—Spinning machinery.
2757. G. Mallinson, Manchester, and H. Ridings, Newton-heath—Woven fabric.
2758. F. Preston, Manchester—Bayonets.
2759. G. E. Dering, Lockleys—Motive power by electricity.
2761. T. Slater, Somers-place West, and J. Tall, Crawford-street, Marylebone—Planes.
2763. B. Hughes, Belfast—Bakers' ovens.

Dated 1st January, 1855.

3. J. Seguin, Paris—Motive power.
5. S. Giles, Caledonian-road—Ratchet brace.

Dated 2nd January, 1855.

7. A. Roullion, Paris—Soap.
9. J. Arnold, Tamworth—Ornamenting bricks.
11. G. Peacock, Gracechurch-street—Propellers.

Dated 3rd January, 1855.

12. J. K. Harvey and D. Pearce, London—Calendar inkstand.
13. F. G. C. Dehaynin, Paris—Purification of hydrogen gas.
14. H. Fontaine, Marseilles—Engravers' presses.
15. J. Lippurann, Paris—Splitting skins of animals.
16. W. Kendall and G. Gent, Salford—Machinery for cutting metals.
17. S. A. Goddard, Birmingham—Fire-arm.
18. J. H. Johnson, 47, Lincoln's-inn-fields—Coating iron with copper. (A communication.)
19. J. Gaskell, Manchester—Mortar and cement.
20. C. Hustwick and W. Bean, Kingston-upon-Hull—Railway buffers and springs.
21. A. S. Stocker and S. Darling, 11, Poultry—Bottles, pots, jars, tubes, &c.
22. J. Venables and A. Mann, Burslem—Raised ornaments on metal, pottery, &c.
23. J. Venables and A. Mann, Burslem—Figures in plastic materials.
24. T. W. Rammell, Trafalgar-square—Furnaces.
25. G. W. Muir, Glasgow—Warming and ventilating.

Dated 4th January, 1855.

26. C. Watt, Victoria-wharf, Regent's-park-basin—Preparing coffee.

Dated 5th January, 1855.

27. L. J. Martin, Paris—Colours for printing and dyeing
28. G. Howden, 1, Little Queen-street, Holborn—United adhesive book-headband and register ribbons.
29. W. H. Bulmer and W. Bailey, Halifax—Combing machinery.
30. L. D. Girard, Paris—Motive power.
31. R. Ashworth and S. Stott, Rochdale—Spinning machinery.
32. J. Livesey, 20, Kensington-gore—Printing. (A communication.)
33. F. Prince, 3, South-parade, Chelsea—Cartridges for fire-arms.

Dated 6th January, 1855.

34. B. Cook, Birmingham—Separating metallic filings.
35. J. H. Johnson, 47, Lincoln's-inn-fields—Agricultural machinery and motive power. (A communication.)
36. T. Delabarre and A. Bonnet—Preservation of food.
37. J. H. E. Ruttre, Paris—Treatment of woollen and vegetable rags.
38. D. Joy, Worcester—Pistons.
39. J. Scott, Sunderland—Anchors.
40. G. H. and H. R. Cottam, Old St. Pancras-road—Iron bedsteads.
41. C. J. Edwards, jun., Great Sutton-street, Clerkenwell, and F. Frasi, Tavistock-terrace, Holloway—Axle bearings.

Dated 8th January, 1855.

42. W. G. Craig, Gorton, near Manchester—Railway buffer cases and rams.
43. J. Huggins, Birmingham—Lint.
44. J. Player, 2, Winchester-buildings—Prevention of smoke.
45. R. McCall, Pallas-Kenry, Limerick—Iron and steel.
46. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Alcohol. (A communication.)
47. W. and J. Hay, Glasgow—Motive-power engines.
48. A. Nagles, Ghent—Cleaning surfaces of woven fabrics.
49. J. Bury, Manchester—Embossing Orleans cloth.

Dated 9th January, 1855.

50. S. S. Shipley, Stoke Newington—Washing machinery.
51. E. Hayes, Stony Stratford—Feeding thrashing machines.
52. T. Hodgson, Morley's Hotel—Paddle-box life-boat.
53. J. Offord, Wells-street, Oxford-street—Carriages.
54. A. G. Guesdron, Paris—Table.
55. P. E. Thomas, Paris—Obtaining wool from tissues of wool mixed with other fibres.
56. N. J. Amies, Manchester—Winding yarn.
57. Commander H. J. Hall, R.N., Charlton, and A. Dalgety and E. Ledger, Deptford—Propelling ships.
58. E. Bow, Glasgow—'Blackening' for foundry purposes.
59. W. Major, Copenhagen—Screw-propellers.
60. I. Lamb and F. B. Fawcett, Kidderminster—Fabrics.

Dated 10th January, 1855.

61. T. Wilson, Birmingham—Hands for fire-arms.
62. B. Predaval, 106, Great Russell-street—Paper pulp.
63. W. T. Henley, St. John-street-road—Steam-boilers.
64. E. Booth, Gorton—Dressing, starching, and finishing textile fabrics.
65. W. C. Fuller, Bucklersbury—India-rubber springs.
66. H. Bessemer, Queen-street-place—Iron and steel.
68. L. P. Lehugeur and M. Uttinger, St. Denis, near Paris—Machinery for printing fabrics.

Dated 11th January, 1855.

69. J. Gedge, 4, Wellington-street South, Strand—Metallic flooring. (A communication.)
70. J. L. Hervé, Paris—Preserving meat and fish.
71. J. Norton, Dublin—Draining land.
72. A. Robertson, Upper Holloway—Packages for dry goods.
73. E. Hall, Dartford—Gunpowder.
74. R. Oxland, Plymouth—Animal charcoal.
75. E. Townsend, Massachusetts—Stitching machinery. (A communication.)
76. J. Wood, 30, Barbican—Lettering and ornamenting glass.
77. W. L. Thomas, Anderton, Devon—Projectiles and gun-wads.
78. S. W. Davids, Carnarvon—Elongating chandeliers and gaseliers.

Dated 12th January, 1855.

80. J. Onions, 44, Wellington-place, Blackfriars—Tobacco-pipes, &c.
81. W. Hunt, Tipton—Iron.
82. J. R. Hodgson, Sunderland—Anchors.
83. F. V. Guyard, Gravelines—Electro-telegraphic communications.
84. E. Miles, Stoke Hammond, Bucks—Coupling joint for tubing,

85. C. Turner, Burnley—Power-looms.
86. J. Harrison and J. Oddie, Blackburn—Preparing yarns for weaving.
87. F. Preston, Manchester—Ordnance and projectiles.
88. W. Barningham, Salford—Connecting rails of railways.
89. A. Seithen, Coblentz, and J. H. Lichtenstein, Berlin—Cork machinery.
90. R. A. Brooman, 166, Fleet-street—De-vulcanising India-rubber. (A communication.)
91. P. N. Gadol, Bermondsey—Tanning.

Dated 13th January, 1855.

93. W. H. Nevill, Llanelly—Reverberatory furnaces.
94. J. Graham, Hartshead Print Works, near Stalybridge—Fixing colours in yarns.
95. G. Warnecke, Frankfort-on-the-Maine—Preserving vegetables and fruits.
96. J. Claudot, Paris—Stucco.
97. M. D. Hollins, Stoke-upon-Trent—Slip kilns for drying clay.
98. E. L. Hayward, Blackfriars-road—Kitchen ranges.
99. J. C. Pearce, Bowling Iron Works—Iron.
100. J. E. Outridge, Constantinople—Transmitting motive power.
101. J. Greenwood, Irwell-springs, near Bacup—Finishing textile fabrics.

Dated 15th January, 1855.

102. F. Burke, Montserrat, West Indies—Obtaining fibres from plantain, banana, aloe, penguin, &c.
103. W. T. Frost, Shottle, near Belper—Machinery for cleaning knives.
104. H. M. Ommaney, Chester—Projectiles.
105. J. P. Lark, Nine-elms-lane—Consumption of smoke.
106. G. Riley, 12, Portland-place North, Clapham-road—False bottom for mash-tubs.
107. E. Haynes, jun., Bromley—Smoke-consuming furnace.

Dated 16th January, 1855.

108. M. T. Stefani, Paris—Fire-arms.
109. U. C. Choisnet and C. E. Giajola, Birmingham—Moderateur lamps.
110. H. Adkins, Edgbaston, Birmingham—Bleaching oily and fatty bodies.
111. J. Yeoman, Walworth—Self-feeding furnaces.
112. G. Jackson, Manchester—Tents.
113. J. Simkin, Bolton-le-Moors—Rifles and fire-arms.
114. J. L. Norton, Holland-street, Blackfriars—Recovering wool from fabrics.
115. J. Saunders, St. John's wood—Axles and shafting.
116. J. A. F. V. Oudin, Mons, France—Preventing sea-sickness.
117. R. J. Mar'yon, 37, York-road, Lambeth—Steam-engines.

Dated 17th January, 1855.

118. G. W. Garrood, Burnham—Machinery for raising or lowering weights.
119. S. Lomas, Manchester—Silk machinery.
120. J. Horton, Birmingham—Storing gunpowder.
121. A. Quertinier, Charleroi—Glass furnaces.
122. A. Colles, Milmount, Kilkenny—Sawing marble. (A communication.)
123. Capt. D. Davidson, Meiklewood-by-Stirling, N.B.—Pointing ordnance and restoring the aim.
124. J. Webster, Collingham—Motive power.
125. J. Higgins and T. S. Whitworth, Salford—Moulding for casting shot, shells, &c.
127. E. Hall, Salford—Wire ribbon.
128. L. Flower, 37, Great Russell-street, and G. A. Dixon, Stratford—Sifting and cleansing machinery.
133. E. Leigh, Collyhurst—Preparing fibrous substances for spinning.
134. H. Partridge and J. B. Broome, Birmingham—Wrought-iron ordnance.
135. W. Johnson, 47, Lincoln's-inn-fields—Application, treatment, cleansing, and dyeing of fibrous substances. (A communication.)
136. W. Pidding, Putney—Hair-combs.
137. W. Pidding, Putney—Building materials.
138. W. Pidding, Putney—Coverings for the feet of bipeds and quadrupeds.
139. J. G. Lawrie, Glasgow—Sights of fire-arms and cannon.
140. M. J. Nyclassy, 13, Chandos-street—Wind musical instruments.
141. S. A. Bell and J. Black, Bow-lane, Cheapside—Lucifer matches.

Dated 18th January, 1855.

129. C. J. Duméry, Paris—Smoke-preventing apparatus.
130. J. B. Surgey, Lidlington-place, St. Pancras—Carriages.
131. T. Blackwood and A. Gordon, Paisley—Motive-power engines.
132. W. Lancaster, Preston—"Temples."

Dated 19th January, 1855.

142. C. F. Stansbury, 17, Cornhill—Self-acting railway brakes. (A communication.)
143. S. J. Paris, Manchester—Embossing.
144. R. Martin, High-street, Marylebone, and J. Hyams, Union-street, Bishopsgate—Goloshes.
145. S. Isaacs, 22, Newman-street—Artificial coral.
146. J. I. Clarke, Windsor-court, Monkwell-street—Applying colour to edges of leather gloves. (A communication.)
147. J. Abbott and H. Holland, Birmingham—Preventing sinking of vessels, and raising when sunken.
149. T. C. Hill, Stanton Lacy—Drain pipes and tiles.
150. P. C. P. Laurent, Prefontaine, Paris—Hydraulic sling for raising weights.
151. W. Smith and T. Phillips, Snow-hill—Taps and floats.
152. M. Delcamp, Paris—Apparatus for advertising.
153. M. B. Rennie, 21, Whitehall-place—Preserving food. (A communication.)

Dated 20th January, 1855.

155. W. Douglas and J. Carswell, Manchester—Dyeing woven fabrics.
156. S. Salaville, Paris—Preserving and purifying grain and seed.
157. W. G. Pearce, Grosvenor-street, Camberwell—Projecting shot, &c., and exploding by electricity.
158. A. E. L. Bellford, 32, Essex-street, Strand—Paddle-wheels. (A communication.)
159. F. Margueritte, Paris—Soda and potash.
160. W. Eisenmann, Berlin—Hearth.

Dated 22nd January, 1855.

162. J. Gedge, 4, Wellington-street South, Strand—Laminating metals either in relief or bas-relief. (A communication.)
163. S. Trotman, Portman-square—Filtering apparatus.
164. H. Carr, Peterborough—Railway crossings.
165. J. H. Pape, Paris—Pianofortes.
166. R. Johnston, Aberdeen—Soap.
167. J. J. Van Camp, Paris—Pistons.
168. F. A. Vasiner, Paris—Fire-places.
169. P. H. G. B. Touzelin, Paris—Artificial flowers.
170. W. Kilgour, Liverpool—Naphtha, paraffine, and paraffine oil.
171. P. Arkell, Stockwell—Purifying whale and seal oils.

Dated 23rd January, 1855.

172. J. Coates, Salford—Railways.
173. F. Prince, 3, South-parade, Chelsea—Cartridges for fire-arms.
174. W. Dray, Swan-lane—Chaff-cutting machine.
175. W. Sellwood, Cheapside—Spatterdashes.
176. J. Fenton, Low Moor—Axles, shafts, rods, and bars.
177. G. B. Pettit and H. F. Smith, New Oxford-street—Gas-stoves.

Dated 24th January, 1855.

178. R. Laming, Carlton-villas, Maida-vale—Ammonia.
179. J. Webster, Birmingham—Changing the direction of and multiplying motion.
180. Sir J. C. Anderson, Bart., Fermoy—Steering ships.
181. C. W. Tupper, 3, Mansion-house place—Coverings for buildings.
183. A. E. Schmersahl and J. A. Bouck, Miles Platting—Sulphuric acid.
184. W. E. Newton, 66, Chancery-lane—Raising and forcing fluids.

Dated 25th January, 1855.

185. J. Gregory and A. P. How, Mark-lane—Steam-engines.
186. W. Winstanley and J. Kelly, Liverpool—Pump-gear.
187. B. Samuel, Sheffield—Knife-handles, umbrella and stick handles, door-knobs, &c.
188. H. B. Powell, Lyndhurst—Precautionary keel.
189. C. F. Burnard, Plymouth—Superphosphate of lime.
190. A. W. Anderson, Birmingham—Exhibiting advertisements.
191. J. H. Johnson, 47, Lincoln's-inn-fields—Electric telegraphs. (A communication.)
192. J. H. Johnson, 47, Lincoln's-inn-fields—Cotton machinery. (A communication.)
193. G. H. Bursill, Ranelagh-road, Thames-bank—Cases for explosive substances.
194. R. A. Brooman, 166, Fleet-street—Power accumulator to be used with hydraulic presses. (A communication.)

Dated 26th January, 1855.

195. W. Townsend, Coventry—Vehicles without axletrees.
198. W. Beales, 12, Arlington-street, Camden-town—Cartridges.
199. G. Bell, 21, Cannon-street West—Air-springs. (A communication.)
200. J. Lesse, jun., Manchester—Printing calicoes.
201. W. T. Vose, Massachusetts—Pumps.
202. J. Atkin, Basford, and M. Miller, Nottingham—Water-meter.
203. W. R. Morris, Deptford—Preventing waste of water from service-pipes or cisterns.
204. G. Searby, 154, Sloane-street—Boots and shoes.
205. R. Mallet, Dublin—Hollow shot and shells.
206. J. H. Johnson, 47, Lincoln's-inn-fields—Kites for carrying lines and signalling. (A communication.)

Dated 27th January, 1855.

209. W. Onion, Birmingham—Gas-stoves.
211. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Thimbles. (A communication.)
212. H. aud R. Nightingale, Chorley—Cotton machinery.

Dated 29th January, 1855.

214. J. Wilkins, 2, New Charles-street, City-road—Damping adhesive stamps or labels.
215. W. Polkinhorn, Gwennap, Redruth—Cleansing wheat.
216. H. L. Dormoy, Paris—Platting machinery. (A communication.)
217. J. D. Humphreys, 29, Charlotte-street, Caledonian-road—Steam-engines.
218. J. Imray, 64, Bridge-street, Lambeth—Locks.
219. G. Goodfellow, Great Fenton, Stoke-upon-Trent—Supplying heated air to ovens, kilns, and steam-engine boilers.
220. A. Collinge, 65, Bridge-road, Lambeth—Spring hinges.
221. T. Binks, Wentworth—Raising and regulating the supply of water.
222. J. H. Johnson, 47, Lincoln's-inn-fields—Looms. (A communication.)
223. J. H. Johnson, 47, Lincoln's-inn-fields—Generation of steam. (A communication.)
224. A. Pichot, Poictiers—Postage paper and envelopes.
225. E. Death and J. Popplewell, Halstead—Stop-valve.
226. E. Cunnah and J. Hampson, Liverpool—Turnstile counting apparatus.

Dated 30th January, 1855.

227. D. Moline, Adelaide-place—Metallic window-frames and sky-lights. (A communication.)
228. R. A. Brooman, 166, Fleet-street—Filter. (A communication.)
230. G. W. Henri, York—Meal mixture for cattle.
232. D. Warren, Glasgow—Screw-propellers.

Dated 31st January, 1855.

233. J. Smith and J. Hollingworth, Langley-mills—Paper.
234. A. Lyon, Windmill-street, Finsbury—Sausage-making machines.
235. S. White, Southport—Crayons.
236. G. Price, Wolverhampton—Iron safes.
237. J. Howard, Bedford—Ploughs.
238. J. R. Delguey Malavas, Montbrison—Motive power.
239. M. and A. Samuelson, Hull—Steam-engines.
240. J. F. Porter, Bessborough-street—Bricks.
241. J. Harrington, 14, Pelham-street, Brompton—Priming fire-arms.
242. A. E. L. Bellford, 32, Essex-street, Strand—Forging nuts and washers. (A communication.)

Dated 1st February, 1855.

243. W. Taylor, 16, Oxford-terrace, Hyde-park—Cables.
244. T. O. Dixon, Steeton, Keighley—Wood-working machinery.
245. A. Prince, 4, Trafalgar-square—Fire-arms. (A communication.)
246. J. Jecks, Norwich—Machine for sweeping grass.
247. A. W. Williamson, University College—Apparatus for feeding fires.

Dated 2nd February, 1855.

248. B. Goodfellow, Hyde—Ordnance.
250. G. Ritchie, 3, Monmouth-place, New-cross—Mattresses.
251. J. Castel and Dr. F. M. Beaupré, Marseilles—Lamp-burner.
252. J. Carlhian and J. Corbière, 27, Castle-street, Holborn—Moderator lamps.

Dated 3rd February, 1855.

256. R. J. Mary'on, 37, York-road, Lambeth—Projectiles.
258. E. Clegg and J. Leach, Littleborough—Temples for looms.
260. H. V. P. de la Bertoche, Paris—Paper.
262. E. C. Bisshopp, Stonehouse—Breach-loading fire-arms.

Dated 5th February, 1855.

264. A. E. L. Bellford, 32, Essex-street, Strand—Hulls of vessels. (A communication.)
266. A. Morton, Kilmarnock—Weaving carpets.
268. J. Dorrell, Bilston—Rolling iron.
270. J. Imray, 64, Bridge-road, Lambeth—Measuring instruments.
272. P. J. Carré, Asnières, Seine—Ornamenting fabrics with metal leaf.

Dated 6th February, 1855.

274. D. J. Hoare, 10, Salisbury-street, Strand—Propelling vessels.
276. H. Trappes, Manchester—Preparation of leather for a new flock. (A communication.)
280. J. H. Johnson, 47, Lincoln's-inn-fields—Waterproofing. (A communication.)
282. W. S. Roberts, Lodersville, Susquehanna—Coupling railway carriages.
284. J. Grainger, Birchwood, Alfreton—Pantiles.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

79. A. E. L. Bellford, 32, Essex-street, Strand—Tanning. (A communication.) 12th January, 1855.
154. C. Van den Bergh, Lacken, by Brussels—Rotatory steam-engines. 20th January, 1855.
196. J. Lamacraft, Westbourne-grove—Envelopes, or means for securing letters, notes, and similar documents. 26th January, 1855.
208. S. Mayer and W. Bush, Bristol—Reducing flint and other substances, rendering them suitable for the manufacture of porcelain and other earthenware articles. 27th January, 1855.
213. A. L. Lenoir, Paris—Breach-loading fire-arms.—27th January, 1855.
249. W. Soelman, 3, Bennett-street, Fitzroy-square—Naukinetic or ship-moving machine. 2nd February, 1855.

DESIGNS FOR ARTICLES OF UTILITY.

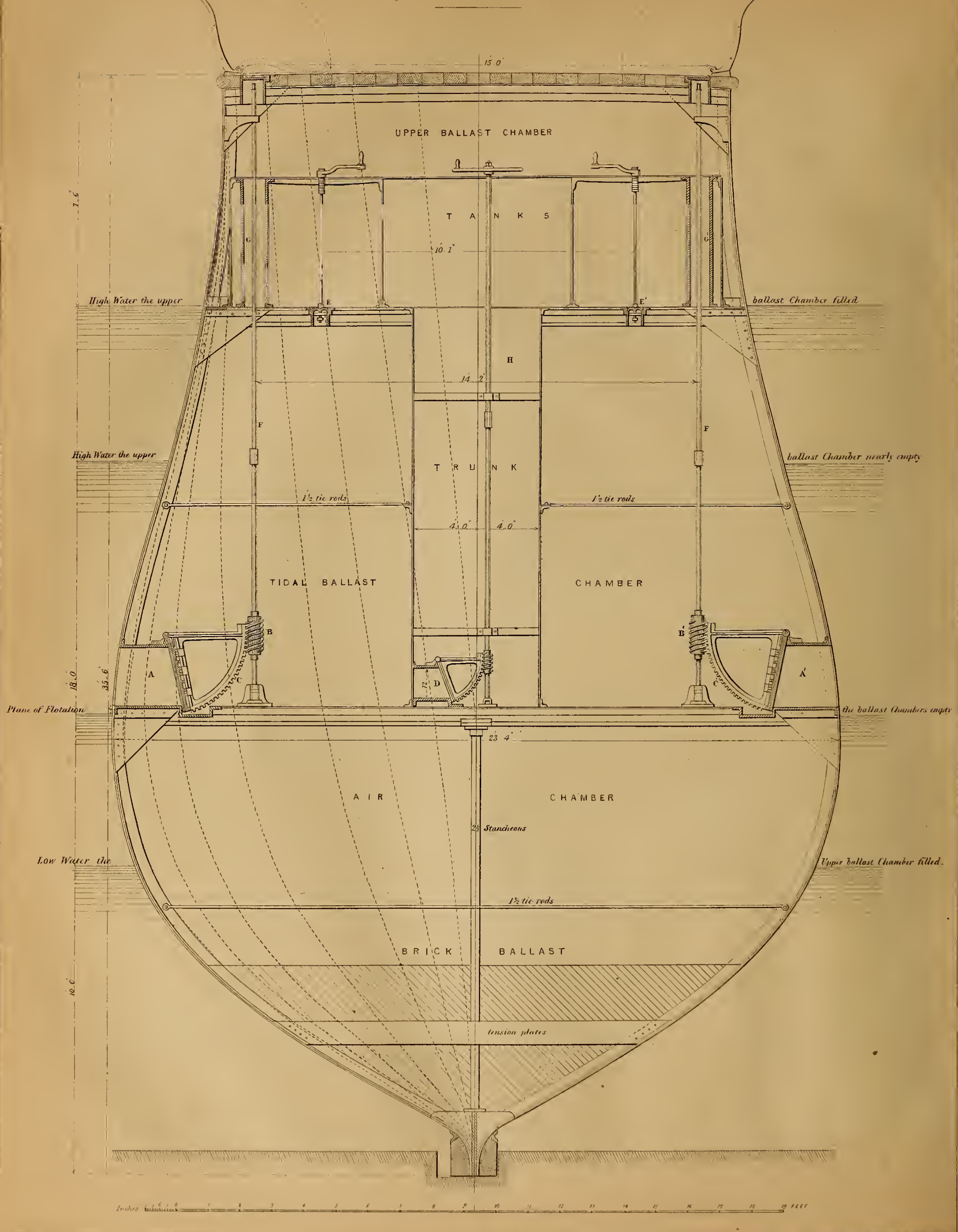
1855.

Jan. 19, 3677. John Edward Smith, 26, Wood-street, Cheapside, "Shirt-collar."
" 20, 3078. Richard Webb George, 28, Edward-street, Portman-square, "Educational seat and desk."
" 25, 3679. William Schnell, 12, Denmark-street, Soho, "The people's sofa-bed."
" 26, 3680. Richard Edwards, 12, Fanfield-place, Bow, "Perforated polisher and sharpener."
Feb. 5, 3081. Frederick William Lee, 82, Fetter-lane, "The Crimean cloak."
" 7, 3682. Thomas Coombs Williams, 3, London-street, Reading, "Camp stove and cooking apparatus."
" 10, 3683. Mége and Zachnsdorf, 6, Frith-street, Soho-square, "Safety bracelet clasp."
" 13, 3684. Clark and Timmins, Birmingham, "Carriage iron for carriage lamp."

CAISSON AT H. M. DOCK-YARD, KEYHAM.

CONSTRUCTED BY MESSRS H & M. D. CRISSELL.

Regent's Canal Iron Works London.



WRIGHT'S
PATENT VICE-JAW CHAIR.

FIG: 1 _ SMALL JOINT CHAIR.

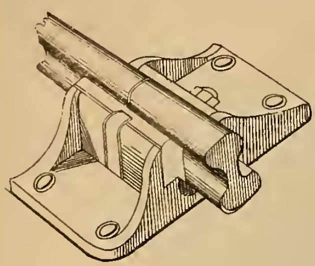


FIG: 2 _ END ELEVATION

Showing Vice-Jaw with its Seating and the Lock Bolt.

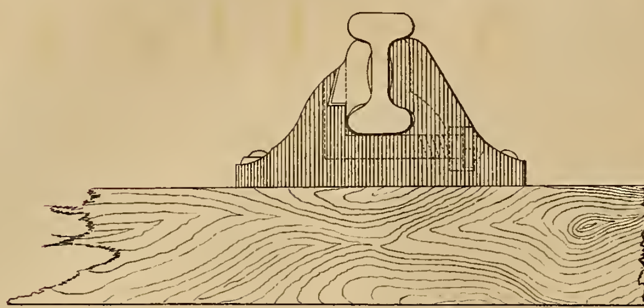


FIG: 3 _ LARGE JOINT CHAIR.

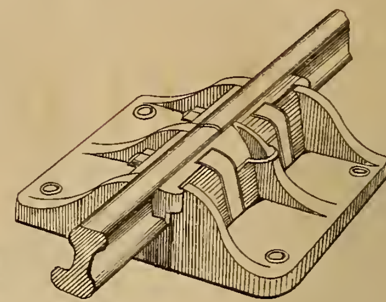


FIG: 4 _ SHOWING SMALL JOINT CHAIR APPLIED WITH ORDINARY INTERMEDIATES.

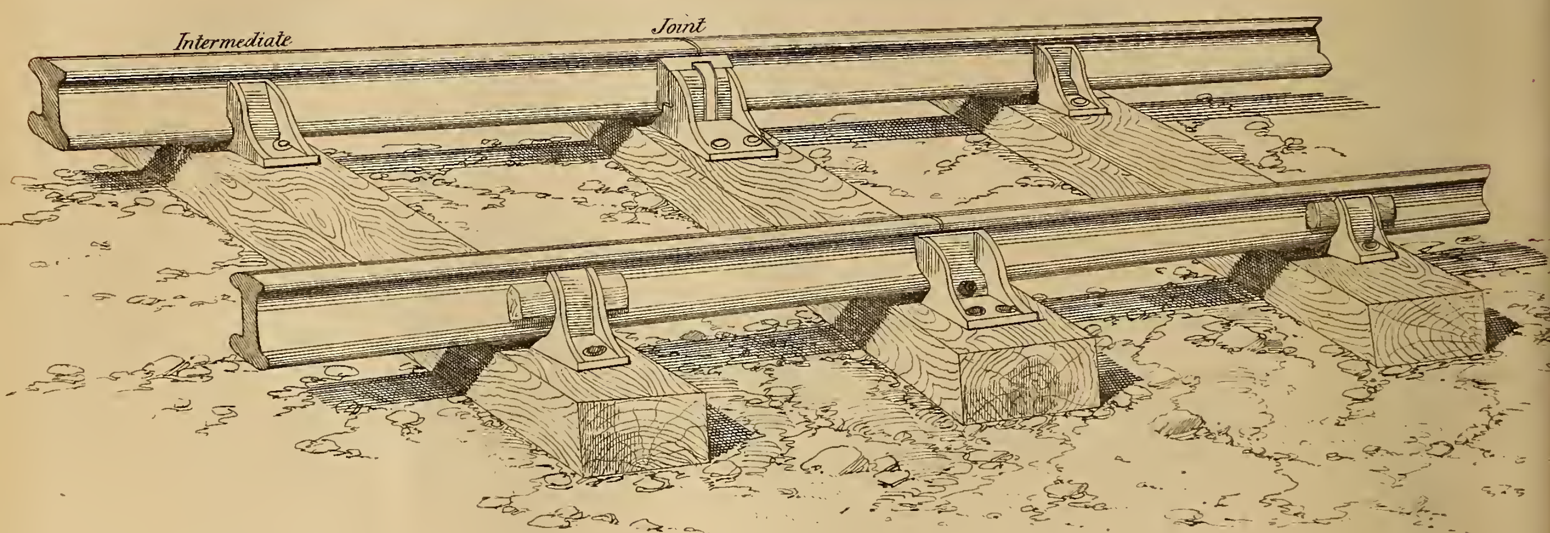
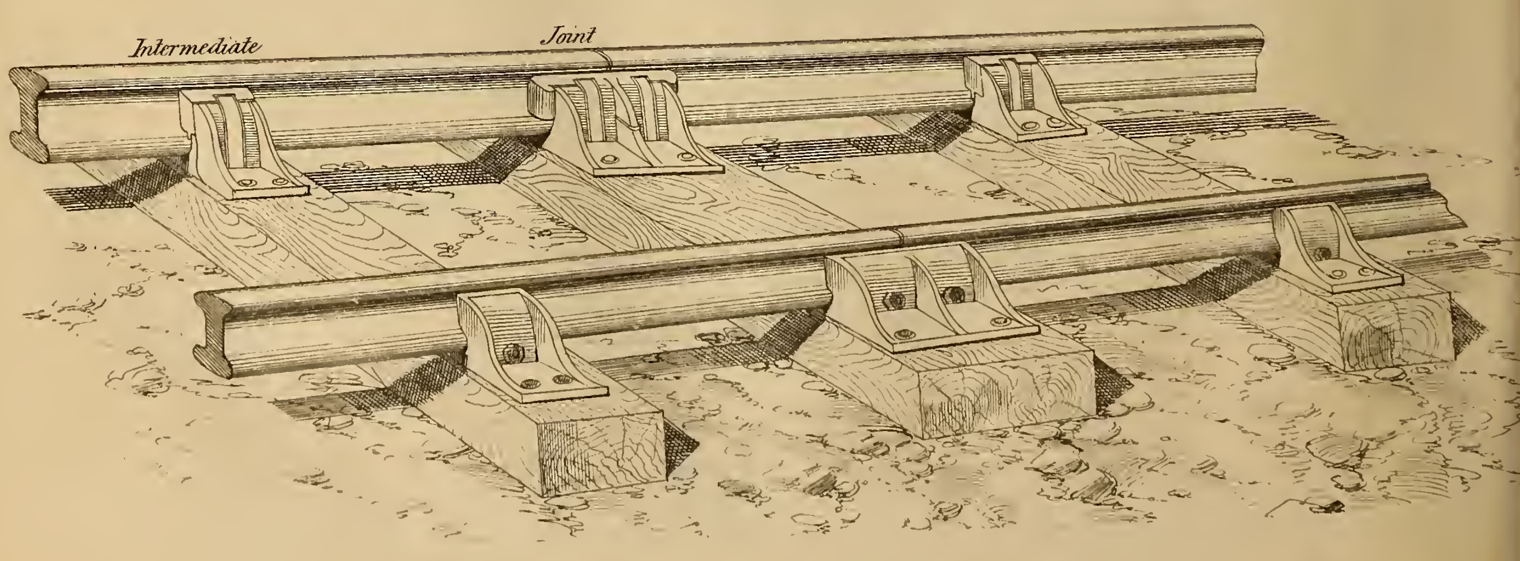


FIG: 5 _ SHOWS LARGE JOINT CHAIR APPLIED WITH THE SMALL JOINT CHAIR FOR THE INTERMEDIATES.



THE ARTIZAN.

No. CXLVII.—Vol. XIII.—APRIL 1st, 1855.

THE WROUGHT-IRON CAISSONS AT H.M. DOCKYARD, KEYHAM.

(Illustrated by Plate xxxiv.)

Having had many inquiries addressed to us soliciting information respecting the nature and construction of the wrought-iron caissons recently constructed for closing the entrances to the basins at the new works in Her Majesty's Dockyard, Keyham, we have much pleasure in laying the particulars of them before our readers, having been kindly permitted to publish them by the contractors, Messrs. H. and M. D. Grissell, whose courtesy, we have no doubt, will be duly appreciated by our readers, and more particularly those members of the engineering profession amongst whom these caissons have excited such a lively interest.

Caissons, as applied to the closing of basin and dock entrances, were invented by the late Brigadier-General Sir Samuel Bentham, in the year 1798, for closing the entrance to the great basin in Portsmouth Dockyard; and have since been extensively adopted in several great dock-works, with various modifications of the Brigadier-General's original design: and though this would obviously be the best place to complete our historical sketch, brief as it would be, we propose to defer it until we have published the remainder of the plates, when the matter will be more easy of comparison and comprehension to the general reader; and for the same reason we defer all matter which relates to the machinery and management of the caissons, confining our present observations to their dimensions and construction.

Our engraving, then, represents the largest of the five that were constructed by the Messrs. Grissell, and is situate at the inner end of the lock entrance; the principal dimensions of which are as follows:—

Length from stem to stem	80 ft.	0 in.
Do. of keel	68	8
Height from the under side of the keel to the roadway	35	6
Breadth extreme	23	4
Do. at the roadway	16	0

The keel and stems are formed of W. I. plates, 2 feet wide by $\frac{7}{8}$ inch thick, scarved, rivetted, and having a covering of timber on each side 8 inches thick, projecting 2 inches beyond the keel and stems all round, and secured to the iron-work with inch-bolts placed zigzag, and also by two bars of 3″ × 3″ × $\frac{3}{8}$″ angle-iron, one on each side, rivetted to the sheathing-plates and spiked to the timbers. These external timber keel and stems are nicely fitted to the stone-work, and form a water-tight joint in the groove of the masonry when the caisson is lowered into its position and pressed against the face of the groove. A clear space of $1\frac{1}{2}$ inches is left between the ends of the stems and the masonry, that the caisson may rise freely and without fear of getting jammed.

The frames are formed of $4\frac{1}{2}$″ × $2\frac{1}{2}$″ × $\frac{1}{2}$″ angle-iron, spaced 13″ apart from centre to centre: the ends of these frames are turned up against the keel and rivetted thereto, being strengthened by a triangular gusset-plate $\frac{3}{8}$″ thick, and uniting the frames, keel, and sheathing-plates all firmly together.

The sheathing-plates are $\frac{1}{2}$″ thick at the keel and $\frac{3}{8}$″ at the top, the several thicknesses of $\frac{1}{2}$″, $\frac{7}{16}$″, and $\frac{3}{8}$″ being spaced in three equal divisions; the $\frac{1}{2}$″ plates being secured with a double row of rivets, and all the others with a single row of rivets. The first strake of sheathing-plates is turned down against the keel, and secured to the same with a double row of rivets.

The body of the caisson is crossed by three ranges of beams. The first range supports the roadway over the top; the second range supports the floor for working the pumps, and the tanks which contain the water for the management of the caisson; and the third range supports the floor of the tidal ballast-chamber, which floor also closes off the air-chamber below, as the space requisite for giving the necessary buoyancy.

These beams are formed of plate-iron, 7″ × $\frac{5}{16}$″, having $2\frac{1}{2}$″ × $2\frac{1}{2}$″ × $\frac{1}{2}$″ angle-irons rivetted on each side at the top, and a bar of 2″ × $\frac{3}{4}$″ rivetted on one side at the bottom. They are attached to every alternate frame, and securely fixed thereto by means of a triangular gusset-plate, 2′ 0″ × 2′ 0″ × $\frac{3}{8}$″.

The sides of the caisson are further strengthened by means of a double range of tie-rods of $1\frac{1}{2}$″ round iron, stretching across the caisson from frame to frame, and bolted to those frames which have not beams attached to them. One range stretches across the centre of the tidal ballast-chamber, and the other range across the air-chamber immediately above the brick-ballast: the sides of this latter chamber are again strengthened by a series of tension-plates, 9″ × $\frac{3}{8}$″, rivetted to the frames on each side of the caisson, and which resist the tendency of the brick-work to burst the chamber or throw it out of form.

The floor of the upper ballast-chamber, containing the tanks, and also that of the tidal ballast-chamber, are formed of $\frac{5}{16}$″ plates, butt-jointed, and having strips 5″ × $\frac{5}{16}$″ rivetted on the under side, and caulked water-tight, the floor-plates being rivetted to the angle-irons of the beams.

The floor of the tidal ballast-chamber is supported by a range of stancheons of $2\frac{1}{2}$″ round iron, one stancheon placed in the centre of every alternate beam. The foot of the stancheon is received by a wrought-iron plinth, which is bolted to that part of the angle-iron frames which are turned up against the keel. The top of the stancheon is inserted in a cast-iron socket-piece, secured to the under side of the beam by means of two pieces of angle-iron rivetted to the beam, and flush with its under edge. The beams are preserved in their positions laterally by means of a tie-rod of $2\frac{1}{2}$″ × 1″ iron, which runs throughout the entire length of the caisson, and is connected to each beam by angle-iron rivetted to each.

The floor of the upper ballast-chamber is supported by a similar range of stancheons to those just described for supporting the floor of the tidal ballast-chamber, and standing immediately above them, being secured to the floor and beams in a similar manner.

The top of the caisson is bound by diagonal traces of 4″ × $\frac{5}{8}$″ iron, passing diagonally over the roadway beams and rivetted to them, and also passing under and rivetted to a stringer-plate, 15″ × $\frac{1}{2}$″, which is carried round the caisson, and covering the ends of the roadway beams; being united with the sheathing-plates and frames by means of a bar of angle-iron, which acts as a bearer to the stringer-plate to which it is rivetted, as well as the sheathing-plates and the frames, by which they are all firmly united together.

In the centre of the tidal ballast-chamber, a water-tight trunk is constructed, 4 feet square and of $\frac{5}{16}$″ plates, fixed to the floor of the tidal ballast-chamber, and to the floor above, through which it communicates with the tanks in the upper ballast-chamber. In the inside of this trunk, pieces of round iron are rivetted on one side as a ladder to gain access to the sluice at the bottom of the trunk.

In the centre of the upper ballast-chamber are placed three tanks, the central one standing immediately over and communicating with the trunk just described. These tanks are constructed of $\frac{5}{16}$″ plates, jointed with angle-iron and strips; the dimensions of the centre tank being 15 feet × 6 feet × 4 feet deep; the side ones, each 15 feet × 4 feet × 4 feet deep, and having a communication with the central tank; so that one source supplies the whole of them with water, which is run from the mains in the yard.

As a means of gaining access to the air-chamber, there are two man-holes through each of the iron floors. Those through the floor of the tidal ballast-chamber are prepared with a trunk 3 feet high, so that admission to the chamber below may be effected with a body of water lying on the floor of the tidal ballast-chamber: these man-holes are faced with gun-metal, and having a cover of the same metal bolted to the trunk; those through the floor of the upper ballast-chamber are covered with a plate of wrought-iron bolted to the floor-plates.

A bridge, 16 feet wide, is constructed over the caisson, formed of 4-inch oak planks, the seams being caulked water-tight. This deck is level longitudinally, but transversely having a rise of $1\frac{1}{2}$″ inches in the centre to allow water to drip off. Along each side of the bridge, a wrought-iron hand-rail is so constructed as to turn down radially on to the deck, when it is required to pass hawsers over the caisson.

A scuttle is formed in the centre of the bridge, to allow access to the upper ballast-chamber, upon the floor of which is placed the pump for drawing off the bilge-water of such caissons as are placed between the basins: but, in those cases where the caisson is situate between a basin and the open sea, or between a dry dock and a basin where the bottom of the caisson can be got at occasionally, then, as the pump is unnecessary, each caisson is supplied with two brass plugs on each side, which can be unscrewed when necessary, and the bilge-water allowed to run out.

S. B.

BEARDMORE AND RIGBY'S PATENT PLUNGER ENGINE.

In Plate xxxiii. of last month we engraved a longitudinal vertical section of Beardmore and Rigby's design for a direct-acting engine, the peculiarities of which are very similar to those of the engines of the Sardinian frigate *Carlo Alberto*, which we described in our "Notes on the Progress of Naval Engineering and Architecture," Artizan, vol. xii., p. 102. If the reader will, therefore, refer to that description, the nature and extent of the present invention will be seen at once without further trouble. We do not hesitate to suggest such a comparison as the inventors set forth very fully and most candidly, that they "do not claim the adoption of an air-pump plunger working in connexion with the piston, when such plunger works through *one end* of the air-pump chamber only; but what we claim as our invention is, the adoption of an air-pump-plunger in connexion with the piston, which plunger works through *both ends* of the air-pump chamber:" by which arrangement, it will be seen, the angular thrust of the connecting rod is, for all practical purposes, as efficiently received as if the plunger was of the same diameter throughout; whilst the reduced diameter of the back part of the plunger admits of the air-pump chamber, condenser, and hot-well being formed of a considerably smaller casting than would be obtained if the plunger was made of the same diameter throughout. We must not be supposed to admit that these engines will occupy a less linear dimension athwart-ship than those of the *Carlo Alberto* class, since it is clear that the plunger of differential diameter, as the inventors term it, is longer than it would be in the other case, by the depth of the gland plus the clearance which would be between the end of the condenser and the end of the plunger. But this trifling additional length of plunger is as nothing compared to obtaining the casting which forms the air-pump chamber, condenser, and hot-well, as compact as is consistent with the requisite capacity for condenser and room for accessibility to the valves.

S. B.

NOTES ON DESIGNING STEAM MACHINERY.—No. IX.

ON THE PARALLEL MOTION OF DIRECT-ACTING ENGINES.

We propose in this "Note" to illustrate an improvement which has recently been made in the guide-bars or parallel motion of direct-acting engines for the screw-propeller—an improvement founded on a principle of action obtained in all forms of direct-acting engines, but which has not hitherto been taken advantage of to simplify the details of construction. This principle of action is as follows:—That so long as the crank of a direct-acting engine rotates in the same direction, the whole of the strain upon the parallel motion or guide-bars, as the case may be, in resisting the angular thrust and pull of the connecting-rod, is borne on one side of the engine only. Thus, if the crank be rotating in the direction indicated by the arrow in the engraving, then while the crank is performing the upper half of its circuit, the connecting-rod will be in a state of compression, and pressing the guide-block or crosshead down;

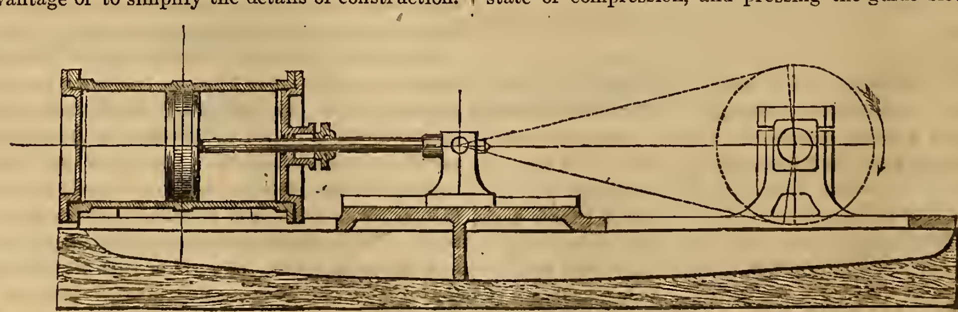


Fig. 1.—Scale 1 inch to a foot.

and while the crank is performing the lower half of its circuit, then will the connecting-rod be in a state of tension, and pulling the guide-block down; that is, the whole of the work is done by the bottom guide-bar.

Now, to many it may seem superfluous to state so minutely a fact so clear and absolute. Suffice it to say, that we *have* heard it disputed by those who, we may in all fairness say, ought to have known better;

for, on once putting the matter before a manufacturer of horizontal engines—that, theoretically speaking, the top guide-bars of a horizontal engine could be removed altogether, but that, practically speaking, it would be better to have some provision which would prevent the possibility of the piston-rod getting bent, but which need not involve a detail so expensive as the upper guide-bars; which simple argument was pooh-poohed and dismissed with that ever-ready dictum of a certain class, that though it might be very pretty in theory, it was not correct in practice.

To return to the subject-matter of our "Note." Figs. 1 and 2 represent respectively an elevation and a transverse section of one form which this kind of parallel motion has assumed. The piston-rod cross-head is extended downwards, and spreads out at the lowest part to form sufficient area for rubbing surface, and is bevilled at the sides, with a guide on each side, as in the slide-rest of a lathe: instead of this V guide, rectangular projections on each side of the crosshead are sometimes used, forming as it were an exaggerated inverted T; in some cases the lower part of the crosshead, which does the rubbing work, is of brass, of a wedge form, and attached with set screws, so as to allow the

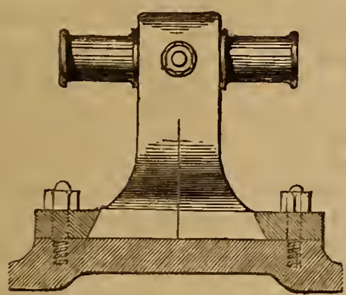


Fig. 2.—Scale $1\frac{1}{2}$ inch to a foot.

means of adjustment as the parts wear down. It will, therefore, be seen, that as the pressure is all on the under side of the crosshead, it is prepared accordingly, the V pieces on each side being sufficient for the security of the piston-rod in guiding it laterally, and in taking the strain at any time when the engines may be reversed.

Some recent examples of portable engines by agricultural engineers exhibit a construction based on the principle just mentioned, by having only one pair of parallel guide-bars, with the crosshead resting on their upper surfaces, and having a light cap underneath each bar, which simplifies the detail considerably.

As to the calculations involved in determining the strain upon and the proportions of the guide-bars, the strain will be directly as the pressure upon the piston, and the sine of the angle which the centre line of the connecting-rod makes with the centre line of the engine; to determine which, would involve an abstruse analytical investigation, but which may be determined sufficiently near for all practical purposes by a simple proportion with the given data—the pressure on the piston, and the ratio of the length of the connecting-rod to that of the crank, and then treating the guide-bar as a beam or girder, supported at the ends and loaded in the centre; with which operation every professional student ought to be perfectly familiar. S. B.

THE HIGH-PRESSURE BOILERS OF HER MAJESTY'S SHIP "PEMBROKE," OF 60 GUNS.

The accompanying drawings of the boilers of Her Majesty's ship *Pembroke* will, we trust, be acceptable to our readers. These boilers have been made by Messrs. Maudslay, Sons, and Field, and are worthy of the high professional reputation of that firm.

Fig. 1 is a sectional elevation;
Fig. 2, a plan;
Fig. 3, a transverse section across furnaces;
Fig. 4, a transverse section, showing arrangement of tube centres; and
Fig. 5, an end view of boilers, showing position occupied in the ship.

Length of tubes	8′ 1″		
Diameter of tubes	2 inches outside.		
Number of tubes	864		
Fire-grate surface	120 ft. =		·6 per H.P.
Tube	3654 ft. =	18·27	=19·87 per H.P.
Flue	320 ft. =	1· 6	
Square in. in funnel	1256 =		6· 3 per H.P.

While the universal public are denouncing in no measured terms the bungling and blundering which have been so awfully fatal to our small but brave army in the Crimea; and while there is a general feeling that professional men do not meet with that encouragement and success in the service of their country, when not backed and supported by other influences than those of *merit* and *fitness* alone (hence the introduction into the public service of so many bunglers); and while it is true that,

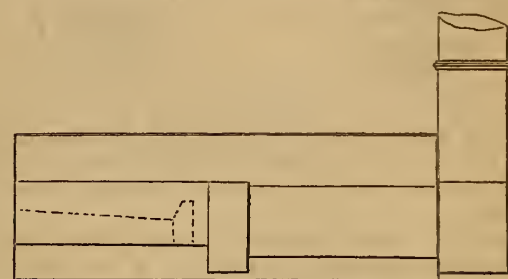


Fig. 1.—Sectional elevation.

as a whole, the public service has but seldom taken the lead in any great improvement in the practical application of science,—we do the more cheerfully note that in so far as regards the introduction of high-pressure steam, the Steam Department of the Royal Navy deserves no small meed of praise, as taking the lead in a very important improvement in practical science.

There have been, with many of our engineers, of long standing and of high professional reputation, a dread of and a prejudice against the use of high-pressure steam; but its peculiar and valuable properties, when applied to the marine engine, are now so self-evident, that we feel quite confident that this dread and that prejudice will ere long be dispelled, and that it will become universal both in our Commercial as well as in our Royal Navy.

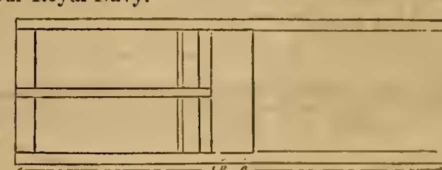


Fig. 2.—Plan. Scale $\frac{1}{8}$ = 1 foot.

It is an old and trite saying, that necessity is the mother of invention. The immense value of steam-power in a ship-of-war was clearly developed in the Baltic campaign of last year, and, in anticipation of the work of the coming season, the Admiralty have converted about half-a-dozen old 74-gun sailing ships, in the course of a very few months, into good, useful steam-ships. The *Pembroke* is one of this class. She now carries 60 guns on two decks. The engines are simple, strong, and at the same time very compact, of 200 nominal horses power: the cylinders are 30 inches diameter; the length of stroke is 2 feet 6 inches. The boilers have been tested to 180 lb. on the square inch; and if care be taken to make good pipes, good joints, and very simple boiler-mountings, we have every confidence that the results from the *Pembroke* will be very satisfactory indeed.

It will be observed that the tops of the boilers are considerably below the water-line, and it is just possible that these boilers may prime. If so, we would suggest that a steam-chest, or steam-reservoir, of say three feet diameter, should be placed athwart ship, on the top: it would also greatly simplify the boiler-mountings, and it would not interfere with the stowage of coal.

There is one objectionable feature which we would take leave to point out; namely, the length, 8 feet 1 inch, and the small diameter of the tubes, $1\frac{9}{16}$ through the ferrules. Until the blast-pipe is brought into play, the natural draught will be sluggish, and it will be a long time before *steam* can be *first* raised.

We can hardly see what can be gained by such a rigid adherence to the *style* of the locomotive boiler, especially where height is not of so much importance.

It is said that the *Malacca's* boiler (a sketch of which will be found in our January number), with tubes 6 feet long, gets steam very freely, and that there is also a good natural draught.

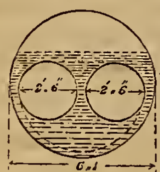


Fig. 3.

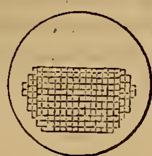


Fig. 4.

If the tubes of the *Pembroke* class had been $2\frac{1}{2}$ inches, and strong enough not to have required ferrules, and not longer than 6 feet, we can fancy that they would have been very successful and very useful marine boilers.

The exigencies of the war will not, we presume, afford time to enter into careful experiments with the machinery of these high-pressure steam-ships at present; but we will look forward with hopeful anticipation, and trust that the Steam Department will give publicity to the results, when obtained, in respect to the power developed in proportion to the coals consumed.

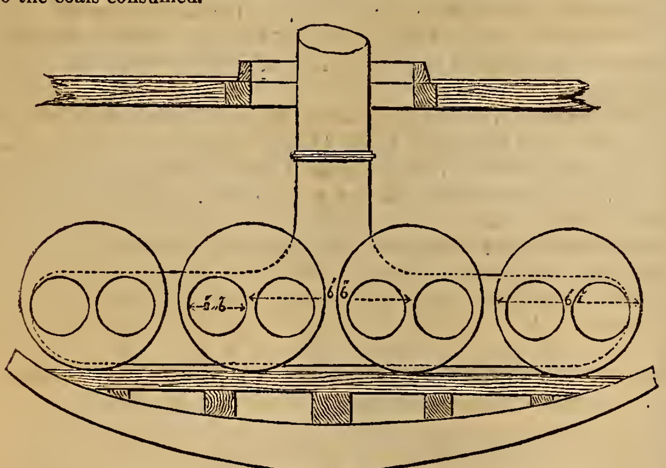


Fig. 5.—End elevation of Boilers.

The screws of the *Pembroke* class are overhung; and, contrary to the usual practice in the Royal Navy, there are no screw-wells for the purpose of raising the screw out of the water. The reason of this, we presume, is that *time* could not be allowed to make this change in the ship.

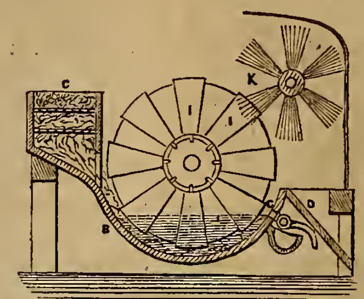
The outer bearings of these ships are lined with *lignum vitæ*. We shall watch this novelty with some anxiety.

The *Pembroke's* screw is 12 feet diameter, and 12 feet pitch.

AMERICAN PATENT INVENTIONS.

Having, in our last number, briefly reviewed a few of the patent inventions given in the Report of the Commissioner of American Patents, we purpose now illustrating such others as we think may interest our readers.

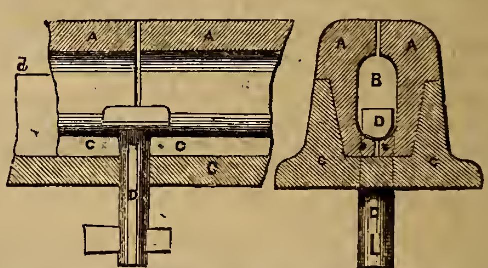
The first we have to introduce is a magnetic machine for washing and separating gold, by S. Gardiner, of New York; the object of which invention is the separation of the iron pyrites usually present in auriferous sands. As the ordinary process of washing is not sufficient for the separation of the iron, in consequence of its great specific gravity, the inventor proposes to place the gold mixed with iron in the box, C, to wash it in the trough, and there separate the iron from the gold by means of a series of revolving magnets, F H I I, the iron being brushed off by the



brush, K, and thrown upon the inclined plane, D, the rotating cylinder of magnets serving as agitators of the water and metal, and separating at the same time all magnetic particles.

While we are speaking of gold machines, a quartz pulveriser and gold amalgamator, by P. G. Gardiner, of New York, deserves a passing notice. This machine is very much after the Berdan model; but, in this instance, there are two similar basins on the same shaft, one fixed above the other, the pulverising basin being uppermost, into which the quartz and water are fed; a screen being placed on the top of it, through which the finely-divided particles of gold pass into the amalgamating basin below: by which means the two processes of pulverising and amalgamating are effected by one compact machine.

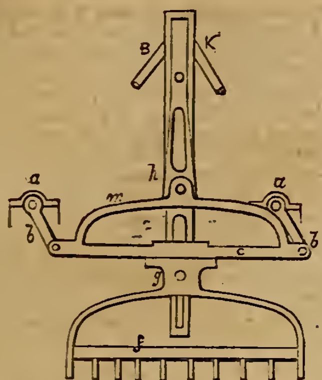
America appears to be fertile in compound rails: we engraved one some time ago, which seems to have been successfully adopted. The following, by R. H. Middleton, of Alexandria, is a combination of three



parts—the continuous trough-rail, C C, and the half-rails, A A. The inventor gives us no comparisons or arguments in support of his compound rail as per engraving; but the trough-rail, which is, virtually speaking, a continuous chair, appears to us a very good idea; and if, instead of the two half-rails, there was one solid, light rail cottered into the trough-rail and breaking joint with it, then it would make an excellent line of rails. The trough-rail is well adapted to the longitudinal sleeper system, and would be permanently fixed; the light rail only being removed when no longer fit for use: by which plan a very material economy in maintenance might be effected, and well worthy the attention of our railway engineers.

The following invention we have engraved and noticed merely by way of warning to inventors in the propulsion field (though, we dare say, we shall receive small thanks for it), as precisely similar plans have been patented in this country, and published with all the honours of copper-plate engravings. H. H. Hewet, of New York, proposes to give to paddles in their circuit a greater longitudinal than vertical motion, by connecting the paddles to a vertical beam, *h*, the top of which is guided vertically by the guide-frame, *k*: the paddles will, therefore, have a vertical traverse due to the stroke of the crank, and a longitudinal traverse due to the height of the guide-frame, *k*, and the relative positions of the paddles, and the guide-frame, *k*, with the cranks, *b*.

Now, since the surface of a propeller must, to propel a vessel, move with a greater velocity than the relative velocity of the water with the vessel as it passes through it, it is clear that the surface of the propeller ought to move, while in contact with the water, with a uniform velocity

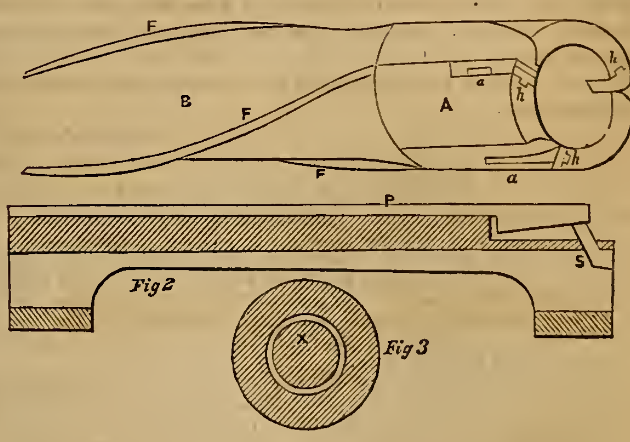


like a screw, or nearly so, like the floats of a paddle-wheel; but it will be seen at once that the paddles of this propeller will have nothing like a uniform velocity, and that when they are entering and leaving the water, they have none, or nearly no velocity, relatively with the water, and only having a propelling influence when the cranks are passing their lowest point: that is to say, putting the matter in another light, if the paddles do exercise a propelling effect when entering the water, they will exercise a much greater effect when at their lowest point; and that having communicated a certain velocity to the water in overcoming the resistance to the vessel's progress, this moving water will immediately afterwards impinge against the front of the paddles, because they commence to lose their propelling velocity immediately they commence to rise out of the water: and this action would take place with any amount of dip of paddles and any stroke of crank—the less the stroke, and the greater the dip, the worse the result; and when it is considered that the paddles are moving at the same velocity and in the *same direction* as the vessel when the cranks are *nearly* horizontal, and that the paddles must necessarily be clear of the water after the crank has moved through an arc of about 45° from the lowest point, the radical defects of such a system of propulsion become apparent, and instead of superseding paddle-wheels by doing away with backwater (the object of the invention), it would obviously create a frontwater of ten times more pernicious influence; and though it might be used for paddling in a duck-pond, it is manifestly unfit for the work of ocean navigation.

The improvements in ships' side-lights, by Enoch Hidden, of New York, evince a thorough practical knowledge of the mechanism of side-

lights. The object of the inventor is to supply a more convenient means of ventilation. The engraving represents a section of the side-light, and a portion of the ship's side, A. B B is the main frame of the light, rendered water-tight by a ring of lead, K K, or other ductile metal, which is soldered to the main frame, B, and doubled over the wood-work: C C is the moveable frame in which the glass, D, is fastened, and which frame turns on its pivots, J, in the projecting pieces, E, cast on the frame, B. The projecting ears, E, have slots or chase-mortices, in which the pivots of the light-frame or cell turn, allowing the light to be hauled from its seat, and, consequently, out of contact with the India-rubber seating, *o o*, so as to allow the plane of the light to be placed at any angle to the main frames, thus freely admitting of ventilation. L shows the frame C in an upright position when open; F F are the screws which screw the light-frame or glass-cell to its India-rubber seat, making it air and water tight. The screw F is shown separate, *o* being the inclined plane which tightens the light-frame to its seat; N is a projecting pin for stopping the screw in its proper position, when the light is to be opened for ventilation.

An ingenious though simple plan for boring cannon has been patented by L. A. B. Walbach, of Pikesville, which appears to deserve consideration. The inventor proposes to bore out an annulus of the diameter of the required hole, leaving a central core, which can be broken off when



the annulus is completed to the required depth, and removed in a solid mass. X is the core; A, the cutter-head of the boring-tool; *h*, *h*, *h*, the cutters; B, the shear; and F F F, the spiral flanges. To operate the tool, S, for cutting off the core, the wedge, P, must be fed forward upon the tool by a screw until the core is cut off, when it will be taken out and examined with a view to discovering any defects in the bore of the gun or the quality of the metal, as the bore of the gun would nearly coincide with the surface of the core.

We now conclude our present notice of American Inventions: not that there are no more useful inventions shown in this Report, for there are many which appear to be practicable and useful designs, but for which we have not space at present; and it is difficult in some cases to form a fair judgment of their merits, the engravings are so excessively rude and unfitted for our pages. S. B.

AMERICAN NOTES.—No. IV.

Life-Boats.—The late disasters to steamers and sailing-vessels has set the inventive portion of our people to work, and the number of plans are better calculated to strike terror into the novice in marine navigation, than to induce a feeling of security; for the question must force itself upon his mind, What character of travelling can it be, when so many differing instruments are presented to his observation, and all of them urged as the indispensable fittings of a passenger-vessel?

First, amongst the late plans, is a metallic one, invented by a Mr. Forman, of this city, the essential points of which are—full conformation to the ordinary requirements of a quarter-boat or gig, combined with sufficient floating capacity for all the persons it could properly accommodate. The floating capacity is obtained by an inner lining of the boat having corrugations running to the plane of its keel, which answer the double purpose of rib and of giving an air-tight internal displacement.

This design is one of positive practicability, and one that will work its way into favour even in your country.

The last one which has been brought to my attention is made by a combination of India-rubber cloth, and a wooden frame, like to that of a boat; the peculiar features being, that the frame is articulated in its width, for the purpose of enabling the whole to be conveniently stowed. It has been submitted to the Engineer of the Board of Underwriters here, who concluded his report as follows:—"This arrangement is one of practicability. In my opinion, however, the perishable nature of the essential material, when exposed to heat, grease, and the adhesion of folding, would present very great obstacles to the introduction of the boat into use, both on account of its unavoidable exposure to the injuries here referred to, and a doubt as to its reliability when it was required."

Surf and Wrecking Boats.—Upon the coasts of New Jersey and Long Island, the fishermen and wreekers of the vicinity, in going out to sea, and in returning to the beach, are necessarily exposed to its surf, and the form of boat in use by them has long been considered here not only the best adapted for this service, but it is by many preferred as a life-boat to all others. By accident, at this time, I am enabled to give you the building description of them, taken from the "Nautical Magazine," together with the remarks of an experienced wrecker upon the Jersey coast.

"*New York*, 1854.

"I send you a draft and tables of a surf-boat, to be used in saving life, or working at wrecked vessels, on our coast.

"Having had considerable experience in boating to and from wrecked vessels for many years, I feel warranted in sending you this, as the *best* model for the purpose; combining, as it does—in my judgment—all the essential points of perfection, viz.: safety, lightness, buoyancy, velocity, and most important of all, the quality of safely running on or leaving the beach in a heavy surf. The superiority of this over most other boats in the last-named purpose—beaching, or leaving the beach—is found in the model, which is flat on the bottom, and curving up at both ends, with a high bow and stern.

"In beaching a boat, it frequently occurs that the boat strikes the beach far below the point to which the sea runs; and as the following sea rushes on very fast, there is no time to get the boat out of its way, but by keeping it stern-to, lying, as it were, upon a pivot amidships, so that the following sea easily lifts the stern and carries her further up, upon the beach; or, as she lies upon a pivot, she can, in a moment, be turned head to the surf, and carried up stern foremost, without having the sea break into her. A boat which is built straight on the keel, lying flat on the beach, has no ability to rise before the sea breaks into her, fills, and, in all probability, capsizes her upon the crew. The curvature of the bottom provides against all this; for, thus, the boat lies upon the middle of the bottom, with the ends free from the beach, and will tip, or swing, upon the application of the least force. Boats built upon this principle are not easily capsized, being low amidships, and high forward and aft. It is a wrong idea that boats require to be built high amidships; for, in this case, they are the more easily capsized. This is accounted for in this wise: if the boat is high amidships, the centre of gravity being there also, the wave thus furnished with an increased lifting surface, more easily turns the boat; whereas, the greater height at the ends, when struck by the wave, only causes the boat to swing, but not to capsize.

"In most cases, in beaching a boat, it is necessary to keep her head on; for, as soon as you enter upon a sea, all depends on the steering oar (all the rest are useless) to keep her straight; and this is more easily done when the bottom of the boat is curved up at both ends, which, as we said before, facilitates the turning around, to avoid danger.

"The following dimensions and tables are taken from a boat built at Squam, and is the one which I consider the best on our coast:—

"*Dimensions.*—Extreme length, 30 feet; breadth, 8 feet; depth, 2⅝ feet.

"*Tables.*—The sections are laid off in spaces of 5 feet, beginning at the stern, on a straight base line, and may be marked thus:—

	1	2	3	4	5	STEM.
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	
Breadth of beam	5 10	7 2	8 0	6 10	3 9	2 in.
Breadth of floor	1 3	2 0	3 6	2 4	0 3	
Height of gunwale	2 7	2 4	2 4	2 5	2 6	

"Rake of stern, 2 feet; rake of stem, 3 feet. The stern to be 4 feet wide; the stem-rakes, 3 feet, and the stern 2 feet. The bottom plank curves up 10 inches at the stem and 9 inches at the stern; and the height of gunwale in the table is measured from the bottom, and not from the base line. The bottom is 25 feet long, and is shaped to a point at both ends. Bottom plank to be 2 inches thick. The gunwale to be 3 inches square, of oak; strings also of oak, 2 by 3 inches. Thwarts, 1½ inches thick, and 1 foot wide. Breasthooks in the bow, and quarter-knees aft. The forward *third*, and *sixth* thwarts, to be stationary and kneed; the second, fourth, and fifth from the bow, to unship occasionally. The bottom boards to be of cedar, lapped 1½ inches, the edge planed down to ¼ inch in thickness. Wood ends to be fastened to the apron, so as to prevent them starting from the effects of a glancing stroke of the stem on the beach—all well fastened with copper. To be fitted with *two air-tight tanks*, one in each end, with *cork fenders* around the sides. This boat to pull six oars single, or ten if double banked.

"These dimensions are for a boat adapted to carrying steam-pumps and boilers to a wreck, or for boating cargo. For a light, handy boat, I would prefer one of the same length, depth, and breadth of stern, but only 7 feet beam amidships, built of lighter scantling and materials. Cedar is the best for planking. Francis' metallic boats are the best for heavy work and durability; but they are of little or no use as surf-boats, owing to their model, which does not embrace the principles above elucidated."

U. S. Frigate "Sabine."—This vessel was begun so far back as 1823; and soon after being put in frame and planked, further work was suspended upon her until May 1854, when she was ordered to be completed. Her keel has been replaced, and she has been lengthened 20 feet forward by cutting off 25 and adding 45 feet. Her dimensions are, now:—Length over all, 206 feet; length of keel, 180 feet; breadth of beam, 47 feet; depth of hold, 29 feet; tonnage, 2,046, Government measure. Her armament will consist of ten 8-inch 63-cwt. shell-guns, and twenty 32-pounders, 57 cwt., on her gun-deck; and sixteen 32-pounders, 33 cwt., and two 8-inch pivot-guns, 12,000 pouuds each, on her spar-deck. Her crew, when in commission, including officers, seamen, landsmen, boys, and marines, will consist of 475, all told.

New Steamer for the New York and Havre Line.—The new steamer for this route, to supply the place of the *Humboldt*, lost in Halifax harbour last year, was launched ou the 27th January, from the shipyard of Messrs. J. A. Westimet and Sons, and immediately thereafter towed to the docks of the Novelty Iron-works to receive her engines.

The dimensions of this vessel are as follows:—

Length on deck	283 feet.
Breadth of beam (moulded)............	39 feet 3 inches.
Depth of hold..............................	24 „ 6 „
Do. do. to spar-deck	31 „ 6 „

Engines.—Two oscillating cylinders of 60 inches diameter and 10 feet stroke.

This vessel will be completed early in June next. H.

New York.

THE LOCOMOTIVE DUTY OF STEAM-SHIPS DETERMINED BY REFERENCE TO THE MUTUAL RELATION OF DISPLACEMENT, POWER, AND SPEED.

To the Editor of The Artizan.

Sir,—The construction of steam-ships, as respects their type of form and engine adaptation thereto, with a view to the realisation of a maximum amount of locomotive duty with reference to the power employed, being an important mercantile consideration which is now attracting much attention, it will, doubtless, be gratifying to your readers interested in steam-shipping, that Messrs. G. Rennie and Co., by their communication to The Artizan for March 1855, have referred to the screw steam-ship *Candia*, and furnished the particulars of trial data, whereby the performance of that vessel, as respects the development of locomotive duty (which, in fact, indicates the quality of a ship for mercantile purposes), can be justly appreciated by comparison with the performance of other vessels which have been or may be subjected to the like test. This is, I believe, the first instance of steam-ship test-trial in which the *displacement* of the ship, the *working power* of the engines, and the *corresponding speed* actually realised, have been communicated by the constructors, and published in any journal or periodical professing to be an exponent of scientific progress. The constructors of the *Candia*, Messrs. Mare, and Messrs. G. Rennie and Co., by their publishing the trial data, whereby the locomotive qualities of the *Candia* can be placed on the lists of comparative steam-ship rivalry with reference to the mutual relation of displacement, working power, and speed, have fairly challenged all competition in steam-ship construction, and thereby conferred a public benefit.

Thus, to bring the constructive merits of steam-ships to the test of comparative admeasurement, and thence determine, by a wide range of "experience made useful," those peculiarities of ships' type and those peculiarities of engine construction which conduce to the production of a high scale of locomotive duty with reference to the power employed, was the object to which I endeavoured to attract public attention by an essay, published in 1851, on "Marine Engine Construction and Classification," and by a further essay, published in 1853, on "Steam-ship Capability," referred to in The Artizan, and of which the second edition is now being issued. The tabular compilations which constitute this latter work have been based on the mutual relations of displacement, working power, and speed, exemplified by H.M. steam-sloop *Rattler*, simply and solely because the locomotive duty of that ship, when measured by the mutual relation of her displacement, working power, and speed, involved in the proportions expressed by the formula $\frac{V^3 D^{\frac{2}{3}}}{\text{Working H.P.}} = C$, or Rule—Multiply the cube of the velocity (V^3) by the cube root of the square of the displacement ($D^{\frac{2}{3}}$), and divide by the horse power (H.P.) calculated with reference to some definite measure of the unit of power—produced an index number or co-efficient (C) indicative of locomotive duty surpassing that of any other ship of which I had any knowledge or experience; and as *Rattler* was constructed in 1841, I conceived it to be high time to endeavour to direct attention to the inquiry, whether our popularly-recognised modern maxims of construction for steam-ship sea-service (namely, length to be eight times the breadth and upwards, entrance lines to be concave, maximum section to be abaft the middle length, engines to be direct-action) are or are not based on principles conducive in the highest degree to the locomotive duty of steam-ships. This investigation appeared to me to be the more necessary, inasmuch as *Rattler*, the most effective ship on record as to locomotive duty, is, in all the points of construction above referred to, the very reverse of the above-mentioned generally-received modern maxims of steam-ship construction. For example, the length of *Rattler*, measuring between the perpendiculars of her stem and stern, is only about five times her beam (not eight times and upwards, as our modern maxims would dictate)—her entrance lines are convex (not concave)—her maximum cross section is forward of her middle length in about the same degree that modern maxims would place it abaft—and her engines are geared with the high multiple of 4 to 1, and not connected "direct" with the screw-shaft. Thus, the matchless locomotive performance of *Rattler* appeared to me to bring modern science to bay, and the question at issue is of great importance, because, in a commercial point of view, it will be nationally disastrous to introduce proportions in ship construction admissibly ill adapted for sailing properties, to which even steamers have frequent recourse, unless the steaming advantages of the new maxims be undoubted, and decidedly beneficial in such degree as to compensate for the detriment to sailing properties which may be thereby incurred.

The ship now under consideration (*Candia*) first came under my notice in June last; and although her displacement and working power corresponding to the speed realised on her trial in May were not then accurately known, still the approximate estimate thereof, that I was enabled to arrive at by the data then supplied to me, satisfied me that the locomotive qualities of the *Candia* were remarkable; and, by a written communication thereon, I suggested to Messrs. G. Rennie and Co. the desirableness of having the displacement, working power, and corresponding speed of the *Candia* correctly ascertained and verified. I therefore do not question that the statement now published by Messrs. Rennie in The Artizan for March 1855 is correct; namely, that the *Candia*, when immersed to a displacement of 2,520 tons, and the engines working up to 1,356 indicated horse-power of the unit 33,000 lbs. raised 1 foot high per minute, or 339 H.P. of the unit 132,000 lbs. raised 1 foot high per minute, will realise the speed of twelve nautical miles per hour, and, therefore, that her co-efficient of locomotive performance deduced from the formula $\frac{V^3 D^{\frac{2}{3}}}{\text{H.P.}} = C$ is 944, whilst the co-efficient of *Rattler* by the same rule is 862, being a superiority in favour of *Candia* equivalent to about 9 per cent.; that is, the type of *Candia* requires 9 per cent. less power than the type of *Rattler* to propel a ship of given displacement at a given speed. Thus, not only 9 per cent. of the whole engine cost and working expenses are saved, but the weight of the engines and of the coal so saved is added to the weight of the remunerating cargo. The unit of power (H.P.) has been assumed by me, in my essay on "Steam-ship Capability," at 132,000 lbs. raised 1 foot high per minute, because such was the average working power per H.P. of ten Government mail-packets specifically referred to, and of which the actual working power had been carefully ascertained; and it was essential to my purpose to assign some definite value to the term H.P., the same not being defined either by engineering practice, or by any legislative enactment fixing the standard amount of working power to be denoted by the term horse-power, and legally marketable as such. This arbitrary assumption of 132,000 lbs. raised 1 foot high per minute as the unit of power (H.P.), though deduced from the actual performance of ten Government mail-packets, is considerably above the *general average* of the amount of working power commercially bought and sold under the denomination horse-power. If we assume the unit of power (H.P.) at 100,000 lbs. raised 1 foot high per minute, then the working power of the *Candia* on the occasion of the test-trial referred to becomes 447½ H.P., being very nearly the nominal horse-power of *Candia* (450 H.P.) as contracted for by Messrs. Rennie; and with reference to this measure of the unit of power (H.P.), namely, 100,000 lbs. raised 1 foot high per minute, the co-efficient of locomotive performance of *Candia* becomes 715, whilst that of *Rattler*, with reference to the same unit of power, is 653; being a superiority in favour of *Candia* of about 9 per cent., as before stated. Again, if the speed of *Candia* be rated in *statute* miles, as is generally the case in the published reports of steam-ship test-trials when the term "miles" is simply referred to, then the 12 knots speed of *Candia* becomes $13\frac{8}{10}$ statute miles, and the co-efficient of her locomotive performance, taking the unit of power at 100,000 lbs. raised 1 foot high per minute, becomes $\frac{(13 \cdot 8)^3 \times (2520)^{\frac{2}{3}}}{447 \cdot 5} = 1{,}087$; and the co-efficient of *Rattler* by the same rule becomes 1,000 very nearly.

Assuming, therefore, the *Candia* to be a highly creditable example of steam-ship constructive type, it follows that a merchant-steamer may be expected to possess mechanical capabilities for working power equivalent to 100,000 lbs. raised 1 foot high per minute, per nominal H.P. contracted for; and that, rating the speed in statute miles, the co-efficient of locomotive performance deduced by the formula above referred to may be expected to reach the numeral co-efficient 1,087. Thus, it appears that the constructive merit of a ship for mercantile purposes, as respects her type of form and engine adaptation thereto, taking *Candia* as the standard, may be regarded as above or below par according as her test-trial co-efficient of locomotive performance, calculated on the above data—viz., displacement in tons weight, speed in statute miles, and working power of the unit 100,000 lbs. raised 1 foot high per minute,—may exceed or fall short of the number 1,087; but taking the co-efficient 1,000 as the standard of comparison, the locomotive performance of *Candia* is 8·7 per cent. above par.

The foregoing formula does not embrace the actual consumption of coals; and as all the mercantile advantages of a good type of hull, and of good engines, may be sacrificed by the wasteful operation of bad boilers or of bad management, it will be useful to keep a check on the condition and management of steam-ships by frequently testing the locomotive duty with reference to the consumption of coals by the formula $\frac{V^3 D^{\frac{2}{3}}}{W} = C$, wherein (W) presents the actual consumption of coals per hour, expressed in cwts. It is to be regretted that *Candia's* consumption of coals on her test-trial has not been stated; but assuming it to have been at the rate of 14 lbs. per hour, per. H. P. of the unit 100,000 lbs. raised 1 foot high per minute, the total consumption per hour corresponding to the $447\frac{1}{2}$ H.P. will be 56 cwt. (nearly), and the co-efficient of locomotive duty with reference to COALS becomes $\frac{13{\cdot}8)^3 \times 2520^{\frac{2}{3}}}{56} = 8{,}709$. This system of check may be subject to certain criticisms in regard to variations resulting from working the engines with variable grades of expansion, but it is nevertheless advanced as affording approximately a useful counting-house check on the engine-room management of any steam-ship of which the co-efficient with respect to power may have been previously ascertained. Merchants, by well looking after the mutual relations of displacement, speed and coals, and making these data the subject of counting-house record, will in a great measure obviate the mystification which attends the anomalies of nominal horse-power.

These investigations show how desirable it is that the Legislature establish some definite amount of working power as the standard measure commercially denoted by the term horse-power (H.P.), and that merchants, or those who assume the direction of steam-shipping affairs, should thus test the constructive merit of the ships which they purchase. If this course be pursued, the trade of steam-ship construction would then be carried out in a fair field of scientific rivalry; constructive talent would then become a measurable quantity, find its own level, and be justly appreciated by the co-efficient of locomotive duty of the ships produced; the science of steam-ship construction would become practically the subject of progressive improvement; for any retrograde step would be at once detected, bad ships would not be marketable, the directorial administration of steam-shipping affairs would become better understood as respects the mutual relation of speed and cost, the capabilities of steam-ships would be more appropriately adapted to the services required of them, visionary schemes would be exposed, and, by superior management in the all-important matter of mercantile transport, the general interests of the country would be promoted to the extent of millions per annum.

Such has been the object with which, by my publications on "Marine Engine Construction" and "Steam-ship Capability," I have endeavoured to bring before public notice the importance of subjecting steam-ship constructive merit to some definite test. I am now happy to see that Messrs. Mare, and Messrs. G. Rennie and Co., have thus practically come forward, and by their ship *Candia*, tested with reference to the mutual relation of her displacement, working power, and steaming speed, exemplified the realisation of a higher degree of steam-ship locomotive duty than is publicly known to have been attained by any other vessel.

I am, Sir, yours respectfully,

CHARLES ATHERTON.

Woolwich Dockyard, 19*th March*, 1855.

NOTES BY A PRACTICAL CHEMIST.

ESTIMATION OF BUTTER IN MILK.—Marchand has suggested a new process for the analysis of milk. He employs the *lacto-butyrometer*, a straight glass tube, closed at one end, and for nineteen-twentieths of its capacity divided into three equal parts. The third of these—the part next the opening—is graduated for the upper three-tenths into hundredths, which are continued to the number of ten above its line of termination.

The lowest graduated third of the tube is filled with the milk to be tested, containing to each ten cubic centimetres one drop of caustic soda. The second third part is filled with ether, and, after careful mixture, the third with alcohol of 86°—90°. The whole is again well mixed, closed with a cork, and placed in a water-bath heated to 109°. 4. F. It is kept in an upright position until the thermometer falls to 86° F., when the amount of fatty matter collected on the surface of the liquid is determined by reading the degress or centesimal divisions which it occupies from below upwards to the lower level of the curve.

SEPARATION OF COPPER AND ZINC.—One grm. of the alloy is dissolved in nitric acid, the solution concentrated and re-dissolved in ammonia, whereby tin, lead, antimony, and iron, if present, are separated. Acetic acid is then added in excess, together with a plate of pure sheet-lead, and the whole maintained for two hours at a boiling temperature. By this time the solution becomes colourless, and the copper is precipitated in the metallic state. It is filtered, dried, roasted, and weighed. As an additional precaution, the copper is re-dissolved in nitric acid and then in ammonia, and any traces of antimony or lead which appear are deducted from the original weight. Arsenic, if present, must be removed by adding a known weight of litharge before the acetic acid and the sheet-lead are inserted.

The liquid, after removal of the copper, contains zinc and the lead added. The latter is thrown down by sulphuric acid. The washing waters are evaporated to a very small bulk, and the last traces of lead removed with ammonia.

If the liquid after this process indicates by a greenish colour the presence of copper, it is acidulated, and the traces of copper precipitated by sulphuretted hydrogen. These traces are roasted so as to yield oxide, and added to that formed above.

The residual liquor, containing merely zinc and ammoniacal salts, is mixed with carbonate of soda, and evaporated to dryness. The residue is re-dissolved in water with a little carbonate of soda, and boiled, when the zinc is converted into insoluble carbonate. It is filtered, dried, calcined, and weighed.

IMPROVEMENT IN BREAD.—Professor Liebig states that lime-water, a cold saturated solution, greatly improves the quality of bread, and destroys its acidity. Five parts of lime-water are required to knead nineteen parts of flour. The amount of lime thus introduced does not exceed the proportion naturally present in the pea and bean.

RESTORATION OF ANIMAL CHARCOAL.—This substance when saturated with colouring matters does not yield them to lime or acids, but abandons them readily to hot water containing a small percentage of an alkaline carbonate. The liquor takes a yellow tinge, and the charcoal resumes its decolourising properties. After the action of an alkaline carbonate, the charcoal is very carefully washed, first with boiling water, and then with water slightly acidulated.

REVIEW.

Food and its Adulterations. By A. H. HASSALL. Longman and Co.

THE report of the far-famed 'Lancet Commissioners' is now before the public in its entirety, and will at once take its due place as a standard work of reference on a question so deeply affecting the physical and moral well-being of the community. The existence of such a work is in one respect painful to contemplate. That an exposure of this nature should be needed—should even be possible in this nineteenth century, and in "this our highly-favoured country,"—should fill every earnest mind with shame. We find here evidence of a fearful amount of iniquity, which keeps within the letter of the law, and on which our criminal statistics are silent—oily, well-fed, respectable iniquity, which would turn up its eyes with holy horror at the sight of a pickpocket or housebreaker—which would rebuke with awful solemnity a shop-boy guilty of falsehood,—but which, all the while, grows rich by lying, cheating, and poisoning. How grim must be the smile of a certain nameless gentleman when he sees one of our adulterators discharge a workman for peculation, or oppose a bankrupt whose accounts are incorrect, "upon principle!"

But the evil being rife among us, it may be asked, why should the expense and the odium of such a task be thrown upon any private individuals? Would it not have been more becoming for Government to investigate a matter of such national importance? But, alas! even now the results are before the public, no effectual steps are taken to abate the nuisance.

Those good, easy souls who believe whatever they see in print, may find here a commentary on the advertisements of many an "enterprising tradesman." Most of the adulterated samples of coffee were accompanied with puffs, disclaiming all fraudulent admixtures, and denouncing heavy penalties against all who should presume to counterfeit the signature of the proprietor—that guarantee of a genuine article! One party exclaims, in a burst of righteous indignation, "We do condemn the fallacious conduct of those who, under pretence of selling pure coffee, in reality vend an article adulterated to an extent never thought of by their less bombastic neighbours." Yet the coffee enclosed in this tissue of fiery eloquence was "*adulterated with a large quantity of chicory!*"

Another firm appeal to the fact that they grind five and a quarter tons of coffee daily, whilst the result is—"*adulterated with very much chicory, which forms the principal part of the article.*"

We are glad to find that the Commissioners agree with us in utterly condemning the use of chicory as innutritive and unwholesome. Whatever Sir Charles Wood may proclaim, the student of organic chemistry must instantly perceive that an article devoid of organic alkalies can never fulfil the function of coffee. We might, indeed, on *à priori* grounds, doubt the praises bestowed by interested parties upon an article so advantageous as chicory to the pocket of the vendor. To those who proclaim that a cup of good coffee cannot be made without the admixture of this vile progeny of the great Continental blockade, we point to the experience of the last century, and of those regions where the fraud is as yet unknown. That it is universally approved upon the Continent, we flatly deny. During a residence of six years in Germany, we have invariably heard the use of chicory in private families stigmatised as a mark of meanness—even those parties who commonly drink a mixed beverage use pure coffee on high days, or when entertaining a visitor—and in hotels as a gross fraud.

There is another interesting feature in this work. Some of the knaves—we beg pardon, of the respectable firms convicted of adulteration—wax wroth, deny the charge, and bring a mass of testimony to refute the plain, palpable facts of analysis. This reminds us of the negro who, when caught upon a neighbouring plantation with a heavy load of stolen vegetables upon his shoulders, disclaimed all knowledge of the matter, and maintained that some one had, unknown to himself, piled the booty upon his back. To those worthies who collect oaths and affidavits, that they have added no alum, chicory, or other trash to their wares, we reply simply, that there it is! inserted, perhaps, by some malicious fairy, to bring "respectable tradesmen" into evil repute.

Another consideration appears to us peculiarly weighty. The law in certain cases denounces penalties against adulteration. To add alum or plaster to bread, starch to pepper, cocculus indicus to ale, renders the offender liable to a penalty. But who is to see the law put in force? Men of science cannot, after having ascertained the fraud, come into court and sue for the penalty in the manner of a common informer. The Excise rarely takes cognisance of such frauds, and its unpopularity would rather enlist public feeling on the side of the adulterator. What we need is a Government officer authorised to prosecute, not as a matter of revenue, but of public health, and a scientific Board to investigate the state of all articles of food and medicine offered for sale. The penalties should be, not, as at present, mere nominal fines, for which a few months' undetected roguery may easily compensate, but, in case of a second offence, imprisonment. That the investigation whose results now lie before us may have shamed some parties into honesty, we fervently hope; and we consider that the proprietors of the *Lancet* have conferred a most eminent service upon their country.

The general conspectus of results given in the introduction should, we think, amply satisfy all who are still inclined to doubt the generality of these fradulent practices. Thus, out of 49 samples of bread, not one was found free from alum. Of 56 samples of cocoa, 8 only were genuine. Out of 68 other cocoas and chocolates, 39 contained *mineral matter*. Of 33 vinegars tested, 21 contained free sulphuric acid. Sixteen samples of pickles were tested for copper—*the poisonous metal was present in all!* Out of 28 samples of Cayenne pepper, 13 were contaminated with *red lead* in large doses, and one with vermilion and sulphuret of mercury. Red lead was found also in 8 out of the 26 samples of curry powder submitted to analysis. Of 33 samples of preserved fruits and vegetables, 27 contained copper. One hundred samples of coloured confectionery were analysed; 59 were coloured with different kinds of *chromate of lead*, and 11 with gamboge—an article no less deadly. A red colour was imparted by red lead in 12 cases, and by vermilion in 6. Nine samples contained *arsenite of copper* (Scheele's green), and one carbonate of copper (verditur). Four samples contained *white lead*, whilst plaster of Paris was present in quantities varying from 4·3 to 43·66 per cent. What bargains! We purpose from time to time returning to the consideration of this important work.

WRIGHT'S PATENT VICE-JAW RAILWAY CHAIR.

(Illustrated by Plate xxxv.)

The acknowledged defects of the ordinary joint-chair have led to the invention of numerous arrangements for securing rail-joints, many of which, in consequence of the want of facility of general adaptation and easy and inexpensive application, are quite insufficient for the purposes required. With a view of remedying these and other defects, an entirely novel and simple mechanical method of fastening has been devised by Mr. Wright, of George-yard, London, called a "Vice-Jaw Chair," because of the identity of its principle of action, grip, and security with that of the common vice, as will be readily understood by a reference to the drawing.

Fig. 1 shows the small joint-chair, which can be applied alike for both joints and intermediates.

Fig. 2 is the end elevation, showing the rail resting on the bottom of the chair, the rail being firmly sustained also on both sides in its channels by the jaws of the chair; and in lieu of the wooden key, the vice-jaw is placed, and secured between the rail and jaw of the chair, sustaining and resisting shocks upon its bearings irrespective of any bolting whatever. The vice-jaw is completely dovetailed, and locked in upon its seatings, thereby preventing lateral action, and from which it is impossible for it to shake out; and also by which means the chair becomes, in fact, one compact and solid mass, and the superincumbent weight and the lateral and vertical blows given out by the engine are uniformly absorbed and conveyed to the bottom of the chair. The lock-bolt passes under the rail and through the chair, having no strain upon it whatever, its office being simply to retain the vice-jaw in the channel of the rail, and upon its bearings. The head of the locking bolt also prevents the vice-jaw from moving end-ways upon its seatings.

Fig. 3 shows the large joint-chair, which can be made to any length, also with double locking bolts applied.

Fig. 4 shows small joint-chair applied with common intermediate chairs.

Fig. 5 shows large joint-chair applied at joints of rails, with the small joint-chair for intermediates.

INSTITUTION OF CIVIL ENGINEERS.

February 13, 1855.

The evening was entirely devoted to the consideration of Mr. Leslie's paper

On the Flow of Water through Pipes and Orifices.

In the discussion, when moving a vote of thanks to the Author for his interesting paper, it was stated to be only due to his position in the profession, to direct his attention to certain points which appeared to require revision, before the paper was printed. The paper might be divided into two heads:—1st, as to the accuracy of the experiments themselves; and 2nd, as to the extent to which they might be considered as a test of the accuracy of the formula of Du Buat. With regard to the experiments—in the cases of low velocities and flat gradients, due precautions did not appear to have been taken for guarding against obstructions, especially from the effect of the accumulation of air. For instance, in the second series of experiments, with a pipe 500 feet long, it was obvious that the results could not be relied upon. In experiment 1, with a gradient of 1 in 2,000, the flow of water was stated as ·3243; whereas in the preceding series of experiments the flow was stated to be ·7407, with a flatter gradient of 1 in 2,391.

In experiment 5 of the second series, the flow was stated to be 2·18, with a gradient of 1 in 220; whereas, in the preceding series, in experiment 8, the flow was stated to be 3· with a gradient of 1 in 230. These were examples of the discrepancies, more or less, pervading the whole of the experiments of the class.

With regard to the test of the formula of Du Buat, the Author had adopted a formula which omitted from it all those corrections which were introduced by Du Buat, with the express view of meeting the case under consideration. On applying Du Buat's formula to the Author's experiments, the alleged discrepancies were, however, reduced:—for instance, in experiment 1, first series, in place of being as 4 to 1, they were only about 2¼ to 1. In experiment 2, in place of being 2 to 1, they were as 3 to 2; and in experiment 4, in place of a discrepancy, as represented, of about 3 to 2, the results were nearly identical.

Referring to the experiments by Mr. Provis, quoted from the Trans. Inst. C. E., vol. ii., the Author had omitted, in the deductions, to allow for the head due to the velocity generated in the pipes. That allowance being made, and the correct formula applied, the results were identical with those of Du Buat; affording a strong confirmation of the accuracy of Du Buat, not only as regarded the formula, but also as to the experiments upon which that formula was based.

While on that subject, as there appeared to be at present a strong tendency on the part of public Boards to invalidate established formulæ, and to introduce others affording larger results, the attention of all who desired to investigate the subject was directed to the article "Theory of Rivers," in Dr. Robison's "Mechanical Philosophy," vol. ii., page 388. By an attentive perusal of the article, they would not only be confirmed in their faith in the experiments and formulæ of Du Buat, but they would be satisfied how little practical result depended upon whether, in point of fact, the flow of water was understated, even to the extent of 20 per cent.: for instance, in a culvert of 100 inches diameter, such a discrepancy would not influence its dimensions to the extent of 7½ per cent., nor the cost of construction probably to the half of that percentage. In fact, practically, below the margin allowed by all careful engineers for contingencies, that could not be estimated. And after reading and understanding the article, they would appreciate the sentence—"We must understand their motions, and their mode of secret, slow, but unceasing action, that our bridges, our wharfs, our dykes, may not become heaps of ruin. Ignorant how to proceed in these daily-recurring cases, how often do we see projects of high expectation and heavy expense fail of their object, leaving the State burdened with works not only useless, but frequently hurtful!"

This quotation derived peculiar significance from certain facts attending the publication of a pamphlet, proceeding from one of the recently-appointed Metropolitan Commissioners of Sewers, and purporting to be a "Memorandum on the Data employed in determining the sizes and estimating the cost of the works designed for the Main Drainage of the Metropolis;" in which it was stated—"De Prony's formula, applied to this latter class of cases, gives results which, as Claudel states ('*Formules*,' p. 110), deviate in some instances from the truth by no less than 29 per cent." But in reality, on reference to the authority there quoted, it appeared that no such passage existed, and the inference was entirely unsupported.

It was pointed out, that if several miles of huge sewers in the Metropolis were constructed of too large dimensions, there might be an extra expenditure of 5 or 10 per cent; but if by the adoption of empirical and incorrect formulæ their dimensions were unduly restricted, the whole system might be a failure, and the expenses induced would be enormous.

On this point, it was remarked that the formulæ published by authority, and insisted on by the Board of Health, gave results differing very considerably from those of accepted practised experimenters, and men of admitted scientific attainments and mathematical knowledge: it would be desirable, therefore, to ascertain how and by whom these modern experiments had been made, in order to be assured as to the degree of credence to be accorded to the results.

It was thus elicited, that the experiments referred to, although generally stated to have been made for the Metropolitan Commissioners of Sewers, and actually undertaken by a Committee composed of gentlemen at that time forming part of the Commission, and the expense, amounting to upwards of £7,000, being paid from that office, yet that no complete records of the proceedings could be found in the archives of the Commission, nor had any official report been presented relative to the experiments, which had been chiefly made by a person who was not an engineer by profession nor a man of scientific attainments, but who was a foreman, or clerk of works, on some small contracts for sewers. A careful examination of the details of the experiments showed, conclusively, that they had been instituted and prosecuted by persons entirely ignorant of the science of hydraulics, and, as a natural consequence, that the results were utterly worthless for all practical purposes; and, moreover, that, such as they were, they had evidently been tampered with and perverted, apparently with the object of fitting them to preconceived theories: thus the extensive circulation of deductions from these fallacious experiments had diffused error, and would, if persevered in, obstruct the progress of sound engineering, in all matters connected with the drainage and supply of water to towns in this country.

In the course of the discussion, it was further elicited that the formula which the Author had employed was not the formula of Du Buat, nor was it applicable to the case of very low velocities, in which the adhesion of the water to the sides of the pipe would produce a very sensible retardative effect. The formula used was, in point of fact, a special modification of Eytelwein's formula, and did not comprehend in its term this cause of resistance. Du Buat's formula, on the contrary, did include the resistance by adhesion, and also that of viscidity, and was of the following form, when reduced to English inches:—

$$v = \frac{307\,(\sqrt{d} - 0{\cdot}1):}{\sqrt{s} - L\sqrt{s + 1{\cdot}6}} - 0{\cdot}3\,(\sqrt{d} - 0{\cdot}1)$$

d being the hydraulic mean depth, s the denominator of the fraction expressing the slope or gradient, and L the hyberbolic logarithm of the quantity to which it was prefixed.

This formula gave values much more nearly approaching the results of the Author's experiments, with minute heads and low velocities, than the formula employed by him; but it was less exact than the still more elaborate formula of Dr. Thomas Young, published in the Philosophical Transactions for 1808, which afforded correct results on pipes, even so small as the $\frac{1}{183}$ part of an inch in diameter, and with velocities of only one-fourth of an inch per second.

This formula was of the form—

$$v = a\,\frac{l}{d}\,v^2 + 2\,c\,\frac{l}{d}\,v$$

in which a and c were exceedingly complicated functions of the diameter, each involving four or five terms. For all practical purposes, however, the formula of Eytelwein, Prony, Poncelet, or Hawksley, might be used almost with indifference. The last-mentioned was the result of an independent investigation, had been frequently verified on a large scale, and, in addition, was better adapted for mental calculation in the practical operations of engineers. This formula was—

$$V = \tfrac{3}{4}\sqrt{\frac{h\,d}{L + 1\tfrac{1}{2}\,d}} \text{ or more exactly } = {\cdot}77\sqrt{\frac{h\,d}{L + 1\tfrac{1}{2}\,d}}$$

V being the velocity in yards per second, L the length in yards, h the active head in inches, d the diameter in inches, and the co-efficient 1½ the divisor when L vanished into a tubulated orifice.

It was also shown, that the results of Mr. Leslie's experiments, instead of being at variance with received formulæ, were singularly consistent with and confirmatory of those formulæ; and this, whether as regarded pipes, orifices, sluices, or weirs: for instance, the pipe of 2½ inches diameter, with a fall of 1 in 5,260, gave by experiment ·44 cubic feet per minute, and by formula ·48 cubic feet per minute; so with the following rates of fall:—

Rate of Fall.	Result, by Experiments.	Result, by Du Buat's Formula.	Result, by Leslie's proposed Formula.
1 in 230	3·00	2·85	2·92
1 in 156	3·53	3·5	3·64
1 in 109	4·28	4·30	4·45
1 in 100	4·53	4·56	4·66
1 in 70	5·71	5·7	5·66
1 in 40	7·74	7·8	7·65
1 in 36	8·00	8·4	8·10

Again, with a tube of 2 or 3 diameters long, theory gave a co-efficient for feet per second of 6·6, while Mr. Leslie's experiments gave an average of 6·7.

Moreover, the discharge by the Dundee Conduit differed scarcely at all from theory, while the discharge by the Edinburgh pipes fell short of theory only just so much as was due to age and corrosion. So, also, the experiments through sluices and over notch-boards gave co-efficients almost identical with theory. Therefore, it was incumbent on the meeting, in returning thanks to the Author for his valuable contribution, to request that he would undertake to revise the tables of co-efficients, and then to bring the subject again under the notice of the Institution.

Great importance was attached to the communication at the present juncture, in consequence of the repeated attacks which had been made by certain public Boards, and unlearned members of local bodies, on the present advanced state of hydraulic science, with the view of carrying out visionary schemes of their own creation, or of arresting proposed improvements of vast importance to the community. Particular attention was drawn to the very inaccurate experiments, and still more inaccurate conclusions, of the Trial Works Committee of the late Metropolitan Commissioners of Sewers, used and extensively promulgated by the late General Board of Health, which, it was feared, coming as they did from a Government authority, were not even yet sufficiently eradicated from the public mind; and also to the evil consequences which had resulted, and still continued to result, from the suspension of the drainage of the Metropolis, while successive Boards of Commissioners, appointed by Government, were debating amongst themselves trivial questions, as to whether this or that formula should be used in the calculations of their engineer, or whether water would run faster through a cylinder made of one kind of material, or of another kind of material. In these respects Mr. Leslie's experiments were most valuable, because they confirmed the conclusions of all practically scientific men, that the accepted formulæ sufficiently well represented actual results, and that the velocity of water was the same, whatever were the materials over which it happened to flow.

On behalf of the Author of the paper, it was remarked with respect to the alleged discrepancies in the second series of experiments, that instead of impugning the results, they rather proved the honesty of the records, and demonstrated their useful character, whilst they pointed out the difficulties to be encountered in making accurate hydraulic experiments, and where failures might be anticipated in their application to engineering practice.

In reference to the formula commonly used for the discharge of pipes, it was contended that the rules adopted by Prony, Eytelwein, Poncelet, and others, were all substantially the same, varying only in the constant for friction, 45·5 being the lowest, and 50· the highest constant for feet per second, now more commonly used and referred to as Du Buat's in the Author's paper: but it was further contended, that the formula of Du Buat provided for the varying diameter of pipes, and also for the reduction of discharge by the loss of head required for overcoming friction, at flat rates of inclination, in a manner similar to, but much more complicated than the plan proposed in the paper.

The conclusions of Du Buat and of Bossut, a previous writer, were founded on experiments detailed in a scientific paper by M. Couplet, the engineer of the Versailles Waterworks, in the year 1732; and those experiments were confirmed in a remarkable manner by the large practical conclusions given in the Author's paper.

It was maintained, that the conclusions of all mathematical writers of the present century were based on the formula of Du Buat; that Prony, Eytelwein, Poncelet, Robison and the elder Leslie, as well as the engineers of the present day, had all agreed, in practice, in omitting the more complicated part of Du Buat's formula. In verification of this, a table was given, showing comparisons of the French experiments from 1732 down to those recently made by the Author, and exhibiting the most striking coincidences of theory with practice; the variations for practical purposes in the different rules being small, and the correction proposed by the Author affording an excellent application of the principles adopted by Du Buat, for providing the most ample allowance in extreme cases, such as all engineers must meet with in hydraulic operations.

February 20, 1855.

The discussion was resumed on Mr. Leslie's paper "On the Flow of Water through Pipes and Orifices," and was continued through the evening.

It was stated that the necessity for introducing into the recognised formula some modification to adapt it to cases greatly departing from a medium velocity, or dimensions, had been admitted and fully discussed by D'Aubuisson and by Weisbach; the former suggesting the law of increase of friction to be as the square of the velocity, plus a certain addition of the velocity itself; the latter proposing a law of increase compounded of the square, plus the square root of the cube of the velocity. It was argued, however, that in cases where such modifications were necessary, they should rather be applied at fixed velocities of the water, than at any fixed gradient.

A comparison was instituted between the friction of water in pipes, with that known under the term "skin resistance" of vessels passing through water. It appeared from the results obtained by Mr. Leslie, in the experiments on the pipes of the Edinburgh Water Company, and those by Colonel Beaufoy on floating bodies, that there was a marked identity of the diminution of the law of increase from that of the squares, as the higher speeds were attained; and also that the resistance per square foot of the side of a ship was only about one-half that per square foot of the internal surface of a pipe, at identical velocities. Whether this had any reference to the mass of water around the ship, as compared with the contents of a pipe, was a subject for consideration.

It was explained that the expression known as "Hawksley's formula" was only assumed to be applicable to useful, practical cases, falling within the ordinary practice of hydraulic science, and extreme cases of minute diameter and almost vanishing velocity were expressly excluded. The meaning of the term "friction" in hydraulics, was explained to be that resistance encountered in the conducting of water, which varied as the square of the velocity. The influence of the adhesion of the particles of water to the internal periphery of the pipes was then explained, in order to render clear that of which all engineers, combining science with practice, were well aware, that within certain limits the friction of water in pipes was independent of the nature of the material over which it flowed. In fact, the adhesion of a film of fluid to the interior of the pipe caused the formation of a tube of water, through which the body of water flowed, virtually reducing the diameter which was provided for in the formulæ. There must be some resistance, whatever the pipe might be composed of; but as the film of water was equally existent under all circumstances, so the resistance was identical in all cases. On this assumption, Du Buat and Dr. Young had given the corrections in their formulæ. The result had been, that if the equations mentioned, modified for rivers, or for ordinary cases of pipes, for waterworks, were applied, the results would be found to coincide accurately with those of practical experiments when correctly performed. This had been confirmed by accurate investigations and by gauging rivers, and also by the examination of sewers, as shown in Mr. Wicksteed's Report on the Drainage of Croydon.

It had been assumed that the greater fall of side branches, or inlets, increased the velocity of the flow in main sewers. Practice, however, showed this assumption to be fallacious, as the various bends and junctions caused considerable retardation of the current.

A recent experiment was mentioned as having been tried at the East London Waterworks, upon a main of pipes 42 inches diameter and 2 miles in length, under the pressure of a constant head of 10 feet. Some curious effects of oscillation of the surface in the vertical air-pipes had been observed, and an account of them was promised to the Institution.

In answer to questions, it was stated that the reductions of the experiments made for the Trial Works Committee, and the report upon those experiments, were not to be found in the archives of the present Metropolitan Commissioners of Sewers. This was unfortunate, as it would have been interesting to have compared the results of these comparatively recent trials with those of Du Buat, Dr. Young, and other well-known experimenters, who had tried lead, iron, and even glass pipes, and had arrived at the conclusion that the discharge was irrespective of the nature of the material of which the pipes were composed. The remark in Weisbach's "Mechanics," that "Experiments with 2¼ and 4¼ inch wide common wooden pipes have given the Author the co-efficient of resistance 1·75 times as great as for metallic pipes," must be received with qualification, inasmuch as the position was not supported by details of the experiments, the results of which had probably been influenced by peculiar circumstances, and they were at variance with all others, including those upon water flowing through wooden troughs.

A table was mentioned as being published by Mr. J. Thomson and Mr. G. Fuller, calculated from the formula of Weisbach, to show, for pipes 100 feet in length, the relation between,—the velocity of the water, in feet per second,—the internal diameter of the pipe,—the head to overcome the friction, in feet,—and the number of cubic feet of water delivered per minute; so that when any two of the four quantities were given, the remaining two could be found. This table has been found correct and practically useful.

It was maintained that the explanation of the resistance of the interior periphery of pipes, of whatever material they were composed, was consistent with the results of actual experiment, and that any further expenditure on trials for demonstrating the supposed advantages of smoothness of internal surface would be entire waste. On the other hand, it was well known that the state of the external surface had much influence on the resistance of floating bodies moving through water; and no doubt this fact had, from analogy, led to the delusion that the smoothness or otherwise of the internal surface of pipes would exercise an influence on the velocity of the flow of water. It being, then, an admitted fact, that, within certain limits, the surface was immaterial to the flow of water in pipes, it was desirable to seek a satisfactory explanation. Probably it might arise from the circumstance of there being a comparatively fixed film of water, held by the force of cohesion, against the internal surface, through and between which the main body of water moved; whereas with a vessel, or other floating body, the surface passed continually into a fresh mass of fluid, bringing the asperities of the moving surface successively into contact with new particles, and thus materially influencing the resistance.

The facts which had been stated with respect to the experiments of the Trial Works Committee of the former Commissioners of Sewers, and the corrupt use that had been made even of those worthless experiments, was another striking instance of the bad effects produced on private enterprise, and on the development of sound practice, by the rapid growth of functioneering influence, during late years. The always useless and sometimes injurious interference of the Railway Department of the Board of Trade, of the Harbour Commission, and of the Board of Health, was strongly insisted upon, and well-known instances were given in support of that opinion; referring to previous discussions at the Institution as examples. During a long period of peace, the cumbrous machinery of Government departments had been presumed to have been rendered perfect, and was assumed to be so, whilst no demand was made on their active energies, or so long as no exigencies arose; but the late melancholy and disastrous events had shown their utter inability to fulfil their functions under any unexpected pressure, or to conduct any practical measure in a business-like manner. Why, therefore, it was urged, should the rising generatiou of engineers be restricted and controlled by officials, not deriving their appointments from merit, but from personal or pelitical influeuce?

In extenuation of the alleged perversion of the experiments of the Trial Works Committee, it was stated that the results had not been wilfully perverted, but the apologist would not render himself responsible for the acts of the Board of Health. Still, it must be remembered that other engineers, besides those employed by that Board, had extensively used pot-pipes for sewers, and there were instances of small sewers of two thousand years old. The sweeping denunciation of the acts and constitution of the late Board of Health was earnestly deprecated.

In reply, it was urged that the remarks made were not personal, but were directed against a system proved to be pernicious, and from which the most serious results must be anticipated; that the engineers who had used pot-pipes for main sewers, had only done so under the compulsory pressure of the Board of Health, as by no other means could they have procured permission to execute the drainage works they had undertaken. With respect to the experiments of the Trial Works Committee, it was remarkable, that whilst the results of experiments which had cost upwards of £7,000 had been suppressed, the late Board of Health had not hesitated to pay a considerable sum for some tables of observations of a similar nature, made by an individual, and to publish and circulate them extensively.

In explanation, it was stated that the Commission of Sewers appointed in 1848 was abolished upon the representation of parties connected with the sanitary inquiries, and a single Commission was appointed, to control the entire Metropolis. The Board of Health was also established at the same time, and its most active member became a Commissioner of Sewers. That gentleman had previously considered the sewers of London to be too small; but his ideas underwent a change, and he arrived at the conviction that conduits of very much smaller areas might convey larger quantities of fluid, provided their internal surfaces were glazed. The Trial Works Committee was appointed to make experiments for establishing this and other theories. Documentary evidence still remained to show that the experiments were undertaken without the necessary knowledge of the science of hydraulics, or of the mode of experimenting, or of recording the results correctly; the prime qualification for experimenters being the knowledge "how to observe and what to observe." The natural consequence was, the collection of a number of documents of the most heterogeneous character; many of them being endorsed by the examining Commissioners—"Anomalous,"—"Incredible,"—"Required to be re-tried," &c. &c. Application was, however, made to Professor Airey, to appoint some competent calculator to reduce the results into a tabular form, and to draw up a report. The gentleman accomplished his ungrateful task, and was very ill paid for the performance; but, strange to say, no trace of either the tabulated results, or the report, existed amidst the mass of documents which, like everything in the archives of the present Commission of Sewers, had been excellently arranged for reference. However, they were partly printed, by order of a succeeding Board of Commission, who, on seeing the results in type, declined to sign and issue such a document, and it was finally suppressed; but not until a few copies had reached private hands, (one of them being produced and quoted from by the speaker,) and, such as it was, the document might be denounced as most unscientific and utterly worthless. Here it might have been presumed that the matter would have rested: but the question was taken up by the Board of Health; evidence was obtained, with the object of showing that all the formulæ in use among professional men were fallacious; a blue book, intended to demonstrate this, was published,—eleven thousand copies were circulated at the public expense, and practical engineers were met at every turn by this fallacious document. The profession, as a body, had a right to remonstrate energetically against such unjust and unconstitutional interference with private enterprise, and the public had still greater cause to complain of the disregard for their interests, and the wasteful expenditure incurred, in the execution of works based on false and unscientific principles, and which within a short period it would be requisite to re-construct.

February 27, 1855.

On Steam and Sailing Colliers, and the various Modes of Ballasting, etc.

By Mr. E. E. Allen.

The first section was devoted principally to a comparison of the original cost and working expenses of screw and sailing colliers. The details of their construction being a distinct subject for inquiry, was only so far noticed as they differed slightly in the case of screw-vessels, according to the mode of ballasting. It appeared, however, to be generally agreed that they should be fully rigged, and be capable of steaming full seven knots per hour; but a higher speed might be advantageous under certain states of the tide at the various ports.

Tables were given of the quantity of coals imported into London by screw-vessels during 1853 and 1854, from which it appeared that 123 arrivals in 1853 gave au average cargo of 572 tons, and a total quantity of 70,403 tons; and that 348 arrivals in 1854, gave an average cargo of 582 tons, and a total quantity of 202,607 tons; showing an increase of 10 tons in the average cargo, and that the total quantity was nearly trebled. The tables also gave the number of cargoes brought to London in each month, and the total number for the year by each vessel, from which it appeared that the *William Hutt* made 21 voyages, and the *Hunwick* 20 voyages; the vessels being in actual work for only about eight months during 1853—the former delivering 13,219 tons, and the latter 9,661 tons. In 1854, the return showed six vessels to have been at work during the entire year, making 33, 31, 29, 28, 27, and 25 voyages respectively, and the quantities carried ranging between 20,033 tons and 15,198 tons, the *Northumberland* being at the head of the list, and the *Caroline* second—the latter delivering 17,461 tons. The total quantity for 1854 included about 7,000 tons brought by screw-vessels, not being regular colliers.

It was stated that sailing-colliers made on the average 10 voyages per annum, but, in a very few exceptional cases, as many as 15 voyages were made; the average cargoes being about 278 tons in 1854—having gradually increased year by year.

From these particulars, it was concluded that the screw-colliers carried about double the average cargoes of sailing-colliers, and were capable of making three times the number of voyages per annum; oue screw-collier being, therefore, equal in capability to six sailing-eolliers.

Comparisons were then instituted between the original cost and working expenses of six sailing-colliers, each carrying an average cargo of 300 tons aud making 10 voyages per annum, and a screw-collier carrying 600 tons and making 30 voyages per anuum. As good wooden vessels, suitable for colliers, were always to be bought for £1,200 to £1,800, aud iron screw-colliers, in ordinary times, at £9,000 to £10,000, the original cost might be taken as about equal. It was stated, from actual experience, that the working expenses of six sailing-vessels would amount to £6,420, and for one screw-collier to £5,050 per annum, these sums including all expenses, and giviug about 1s. 6d. per ton, or 20 per cent., in favour of the one screw-collier on the 18,000 tons supposed to be delivered in each case.

It was next considered to what extent the cost of transit would be diminished by increasing the number of voyages per annum, and a table was given, showing the additions to the working expenses for 12 and 14 voyages for sailing-vessels, and 34 and 38 for screw-colliers, and exhibiting a reduction of the costs of transit from 7s. 1d. to 6s. 8d. and 6s. 4d. per ton by the former, and from 5s. 7d. to 5s. 2d. and 4s. 10d. in the latter case; still being a saving of about 1s. 6d. per ton, and equal in the last case to 25 per cent.

It was next shown how the cost of transit by sailing-vessels was varied by their being insured at Lloyd's, or in clubs; by being ballasted in the ordinary way, or by water; and by being discharged by coal-whippers, or by steam-cranes: and tables were given, showing the saving effected by working both sailing and screw colliers under all the different circumstances described, the various combinations resulting in eight systems of working. Tables were also given, combining the several systems of working with the varying number of voyages; and the result showed, that sailing-vessels, worked on the most improved plan, could bring coals from Newcastle to London at 5s. 3d. per ton, and screw-colliers at 3s. 6d. per ton—being a saving of 33 per cent. The cost was taken at the present high rates both of wages, provisions and stores, and might be considered as being about 20 per cent. above the average prices.

The paper then described the various modes of ballasting now in use,—ordinary sand-ballast, bag water-ballast, bottom water-ballast, hold water-ballast, and tank water-ballast. The three first only were at present employed in colliers. The fourth plan, of having a water-hold, was described as being adopted in two colliers now building by Messrs. J. Scott Russell and Co., and had been already used with success in the *Pioneer* and *Imperial* screw-steamers. In reviewing these methods, both the cost and the time occupied in working them were considered.

Vessels took about one-sixth of their average cargoes in ballast, and the cost of sand-ballasting was usually estimated at 3s. per ton in sailing-vessels, and if used in screw-vessels would be 5s. per ton: this, however, included allowance for loss of time. The bag water-ballast, invented by Dr. D. B. White, of Newcastle, was then described, and samples were shown of the materials used and the mode of joining, &c. The first cost was stated to be about 50s. per ton, and the saving by its adoption about 6d. per ton on the quantity of coals delivered. The first cost would be saved in one year, or a year and a half, regular working. The bags were described as being arranged on the floor of the vessel, and connected with a canvas hose, communicating through the side of the vessel, by a large stopcock, with the external water, which ran in and filled them when required. In discharging them, the water was let into the hold, and then pumped out with the bilge-water, by the ordinary pumps, or by a pump especially designed by Dr. White for the purpose. A model of the latter was shown, and it appeared that the water was always delivered at the level of the water outside the vessel, instead of being raised to the deck as by ordinary pumps;—thus saving on the average three-fifths of the labour in lifting.

Bottom water-ballast was described as the method of adding a second bottom or ceiling to iron vessels, and filling the intermediate space with water. The first cost was stated to be about £2 per ton on a vessel (builders' measurement), which, for vessels carrying 600 tons of cargo, would amount to about £1,000 to £1,200; this giving about £6 per ton of ballast.

Hold water-ballast was described, as consisting of an iron water-hold, placed amidships, and capable of containing from 200 to 250 tons of water; the covering of iron plating being fitted with an iron hatch, with a water-tight cover; the plating being decked over: the hatch was made large enough to allow of the hold being used for cargo. On this plan from 30 to 40 tons of water was carried under the forecastle, which had a caulked ceiling, and an iron man-hole arranged for the purpose. The first cost of this plan would probably not exceed £2 per ton of ballast, where this quantity was required.

A comparison was instituted between the first and yearly cost of 100 tons of bag and 100 tons of bottom water-ballast applied to an iron vessel; and the result was, that bag-ballast fitted under flaps, as tried in the *Northumberland*, cost yearly about £100, or £1 per ton per annum; and bottom water-ballast, about £1 10s. per ton;—the double bottom giving, however, great additional security, and compensating for the increased cost, a reduction of 10s. per cent. on the insurance, if made, being sufficient to cover it.

The advantages likely to result from extending the use of screw-colliers in coaling such a station as St. Vincent, one of the Cape de Verde Islands, were then discussed; and it was urged, as an interesting and important matter, to determine whether coals for the out and home voyages between England and Australia could be advantageously carried in a very large and peculiarly constructed vessel, at the rate of 15 knots per hour, or whether the capital expended in the part of the vessel intended for the coals could not be better employed in the construction of screw-colliers calculated to make, either by sail or steam, about 7 or 8 knots per hour. It was calculated, that a complete and efficient coaling station could be established at St. Vincent's, and vessels constructed for delivering 8,000 tons per annum for about £50,000; the vessels not being nearly fully employed;—the cost of coals at St. Vincent's being thus reduced to about 30s. per ton, and probably, by a similar arrangement at the Cape of Good Hope, to 50s. per ton.

It was urged, that the additional cargo-room given by coaling on the way out and home, instead of taking a large stock from England, was of vital importance; and it was argued, that shipping only 6,000 tons of coal in England, and making up at St. Vincent and at the Cape, the saving on 2½ voyages of a very large steamer, for the year, would be about £100,000: this calculation supposed the coaling stations to be properly established, and a full cargo of goods to be obtainable. The case of the *Crœsus* was cited, as having taken 1,000 tons of coal for her outward voyage, and 400 tons of patent fuel for the return, and the fallacy of the saving, said to have been effected by this arrangement, was pointed out; all notice of the loss of freightage being omitted, shipments being good at the time, and the freight being £7 per ton. It was argued, that with proper stations established, a gain of £3,000 on the voyage would have resulted from her shipping only 500 tons of coal at Southampton.

A table was given, showing the profit which would result from coaling 2,000 tons on different plans, either wholly in England at 15s. per ton, down to 500 tons in England at 15s., and 500 tons respectively at St. Vincent, the Cape, and Australia,—freights being from 15s. to 120s.,—with the object of demonstrating that until freights were down to 15s. per ton, nothing could justify coaling entirely in England;—supposing that the coal could be obtained at the other places at 30s., 50s., and 100s. per ton respectively. For simplicity, the quantities required to be taken at the different stations were taken at 500 tons.

The extent of the coal-trade, particularly that of London, was then examined; and tables were given of the areas of the coal formations of the different countries of the world, and the annual production in 1852.

The annual produce of England was stated to be estimated at 35,000,000 tons; and the quantity exported, about 8 per cent. of the quantity raised. The areas of the coal-fields in the United Kingdom gave a grand total of nearly 8,000 square miles.

The coals imported into London during the last three years was shown by the following table:—

		Coastwise.		Railway and Canal, &c.		Totals.
1852	...	3,330,428	...	411,821	...	3,742,249
1853	...	3,373,256	...	653,729	...	4,026,985
Excess	...	42,828	...	241,908	...	284,736
		= 1·28 per cent.		= 58 per cent.		= 7·60 per cent.
1853	...	3,373,256	...	653,729	...	4,026,985
1854	...	3,399,561	...	979,170	...	4,378,731
Excess	...	26,305	...	325,441	...	351,746
		= ·78 per cent.		= 50 per cent.		= 8·73 per cent.

The gradual increase, particularly in the trade by railway, was pointed out. Tables were also given of the kinds of coals imported into London, stating the ports whence they were shipped, as also the charges of the port of London on colliers.

The paper concluded by directing attention to the chief subjects for discussion:—

1st. Whether the comparative cost of transit by screw-vessels and sailing-colliers had been fairly shown?

2ndly. What was the best system of ballasting for colliers?

3rdly. Whether the use of screw-colliers could be advantageously extended, for supplying distant stations?

4thly. Whether it was commercially desirable that proper coaling stations should be established between England and Australia?

March 6, 1855.

The discussion was renewed on Mr. Allen's paper on "Steam and Sailing Colliers," and was continued throughout the evening.

The bag-ballast was admitted to be convenient in some cases, but it was better adapted for long than for short voyages; and the wear and tear of the bags, when in constant use, was a considerable item of expense.

The system of ballasting with water was now generally preferred: the plan of hold water-ballast appeared, at the first view, to be the simplest; but there might be a doubt whether, in heavy weather, a vessel with such a weight concentrated in one part would not labour and strain. This objection might, to a certain extent, be overcome by having several bulkheads; but it was considered objectionable to divide the hold of a collier-ship. Unless, also, the central water-hold was carefully filled and kept up, to provide against any leakage, the mass of water "heeling over" might capsize a vessel.

The system of double-bottom water-ballast, with a timber ceiling, was objected to on account of the extra original cost, the apparent impossibility of keeping it tight, and the trouble arising from the air. These objections had now caused the system to be regarded as a failure, and it had been superseded by a system consisting of a series of fore and aft tanks, supplied with and kept full of water from a tank in the fore peak; the discharge being accomplished by pumps worked by a small auxiliary engine. No difficulty had been experienced with this system; there was spare space for extra light cargo, and the ship was easier, on account of the elevation of the centre of gravity.

The objections to the bag-ballast were reiterated, especially when, as in short voyages, the bags required to be frequently moved. Instances were given, when, in cases of emergency, the working and weeping of these bags had been watched with intense anxiety: on board the *Northumberland* their term of duration did not exceed nine months.

The midship tank, or compartment of the hold, was objected to, on account of the prejudicial effect of such a weight in the centre of the ship, and the division of the hold into three parts.

It was contended that a double bottom of iron, with a ceiling of timber laid on the iron, was superior to any of the other systems;—the water only occupied space which was not available for cargo; the increased depth of the floors gave stability at sea, and strength when taking the ground in harbour, or accidentally; the space being sufficient, in all cases, for examination, painting, and repair.

The extra expense of the double bottom was urged as the chief objection to the last system described, the working advantages being admitted.

It was evident that a timber ceiling could never be kept tight; the rolling of the ship produced a partial vacuum, and the oakum was forced inwards by the atmospheric pressure, and the formation of a partial vacuum below.

It was contended that it was preferable to place the weight and bulk of water-ballast in the centre of the vessel rather than have the weight at the extremities, inasmuch as it was better to have the butts of the planks of the deck and upper works in compression, and the timber of the keel in extension.

It was explained that the flat tanks were so placed in either wing of the hold, that, on their being filled with water, the ship was exactly in ballast trim. With respect to the double iron bottom, it was stated that the cost would not be more than five per cent. in excess over that of either tank or hold-ballast, while the construction insured a safer and more weatherly ship.

March 13, 1855.

The discussion being renewed on Mr. Allen's paper "On Steam and Sailing Colliers," details were given of the construction, &c. of the *Arthur Gordon*, the *Iron Age*, the *Anne*, and the *Augusta Louisa*, vessels constructed for carrying iron ore—a cargo of great specific gravity. Fore and aft tanks were used in these ships in conjunction with bag-ballast, and the results obtained induced the conviction that the tank-ballast would soon be superseded by either bottom-ballast or hold-ballast; that it was disadvantageous to build vessels exclusively for one class of cargo, as tempting offers of charter, in emergencies, could not be accepted; and that bag-ballast possessed certain advantages in being applicable to either wood or iron vessels, whether sailing or steaming; and that when the duration of the bags was increased, by improvements in manufacturing the material, the system would doubtless be more generally employed.

It was contended that a system of construction applicable to the iron-ore trade would not be adapted for screw-colliers, and that tanks were more expensive than either hold-ballast or the double bottom. The chief disadvantage of the hold-ballast was its causing "breaks" in the cargo; which were objectionable, inasmuch as every time a shoot of coal was commenced, there occurred additional breakage in the coal from its falling a greater depth in loading. It was better to shoot the entire cargo by one hatchway, as the coal soon formed an incline for itself, and less breakage occurred.

On behalf of sailing-colliers, it was urged that the capabilities of the steam-colliers had been overstated, and the number of voyages which sailing-colliers were capable of making were understated. There were no valid reasons why small engines should not be used for unloading sailing-colliers; and if the system of long detention in the Thames was abolished, they might do 50 per cent. more work than at present. Then, if one screw-collier cost as much as six sailing-colliers, and, with all the advantages it possessed, the former only made three times the number of voyages of the latter, all improvements of system would tend to reduce this difference of result, and it was still uncertain what amount of wear and tear there really was in screw-colliers during a series of years. If this proved to be very considerable, the alleged advantages of this newly-introduced class of vessels would be seriously diminished. It was shown that the *Hunwich*, screw-vessel, which had been mentioned in the paper, was found, after running four years as a collier, to have worked with such small advantage as to induce her being devoted to other purposes. The necessity for the formation of the larger and more commodious collier-docks, in the North, and in the Thames, as well as harbours on the east coast, was forcibly represented: unless this was done, there would, at some period, occur a more frightful list of casualties among this new class of screw-steamers than had ever been experienced by the old sailing-ships.

It was argued that the system of rotation in discharging in the Pool, and the frequent long detention there, unduly enhanced the expenses of the sailing-colliers, and, combined with the irregularity of supply caused by the prevalence of certain winds, induced the fluctuations of price on the Coal Exchange. The only effectual remedy for this was a powerful fleet of screw-colliers, constantly and punctually running, with commodious havens at each end, like the Victoria Docks, now in course of construction; with every means for facilitating the rapid discharge of the cargoes into the trucks, to be conveyed by the railways to the various depôts. This alone could insure a constant supply of coal at a uniform price in the London market, and this could only be accomplished by screw-colliers. At present, there were frequently vast numbers of sailing-colliers detained in the Tyne by adverse winds, or by want of water on the bar; on a change of weather they all got away, and a cloud of them arrived at the mouth of the Thames, up which river they had to beat for upwards of 100 miles against a contrary wind, and on their arrival caused a glut in the market, instead of merely supplying the regular demand; whereas the screw-colliers made their passages regularly, and the only disadvantages they had to contend with were those incidental to the navigation of long ships, with deep keels, up a tortuous and crowded river. It was well known that in the past year, during the prevalence of adverse winds, the total extinction of the gas-lights of the Metropolis had only been prevented by the punctuality and rapidity of the screw-colliers. That class of vessels had, in reality, scarcely yet been introduced into the regular coal-trade, inasmuch as the services of the few screw-vessels yet built had been secured for the gas companies and the railways.

The details were given of the working expenses of a sailing collier-brig of 227 tons register, which had made in the last year nine voyages from the North to London, delivering on an average 335 tons per voyage, at 9s. 4½d. per ton freight. The gross receipts were £1,416 3s. 1d., and the expenditure £1,149 13s. 1d., leaving a net profit of £266 10s. = 18¾ per cent. upon the receipts, or 26½ per cent. on the original capital. The brig was twelve years old, and had cost £1,000.

It was contended that the wear and tear of the screw-colliers should be estimated upon the duty performed, rather than upon the number of years' duration; and that sufficient time had not elapsed to enable experience to be acquired of the actual amount of depreciation of screw-colliers in constant use, during all seasons. Their rate of profit must evidently depend not only on the fitness of their original construction, but on the system of working them. Screw-vessels had been put into the coal-trade, for which they had not been originally intended, and to which it was scarcely possible to adapt them advantageously; although with a miscellaneous cargo, or with passengers, they might have done well. It appeared that peculiar lines and certain capabilities were indispensable for good screw-colliers, and the knowledge of what these points of excellence were could only be attained by long experience. Maximum capacity for cargo at only a given cost; light draught of water, to suit the harbours, bars, and rivers; stability, both loaded and light; given limits of length, breadth, and depth, must not be exceeded; strength to permit grounding without injury to hull or machinery; and requiring a minimum quantity of ballast,—were the chief considerations in the construction of screw-colliers: and experience had already demonstrated, by several notorious failures, how difficult of attainment these qualities really were.

As to the various systems of ballasting, the bag-ballast was generally approved for its convenience, and the only serious objection to it was its comparative want of durability. Bottom-ballast was objectionable, on account of the non-accessibility in original construction, for painting and for repairs, unless the floor space was very deep. Tank-ballast occupied so much useful space as to reduce the bulk of the cargo, and thus diminish the amount of the freight. Therefore it was that the hold-ballast had been introduced, and hitherto it had proved very serviceable. The space was available for cargo, the water was easily introduced and discharged, and the weight was so high up as to make the vessel very easy and weatherly when in ballast. For these practical reasons, as well as on account of the comparative smallness of the cost, hold-ballast was contended to be the best system.

It was stated, in allusion to certain tables given in the paper, that the quantity of coals now raised in Great Britain was about fifty million tons per annum.

MR. FAIRBAIRN'S LECTURES ON STEAM.

At the Mechanics' Institution, Manchester, on Monday evening, March 5th, Mr. Wm. Fairbairn, C.E., F.R.S., lectured on "Steam: its Properties and Application to the Useful and Industrial Arts."

Mr. Fairbairn said, at the request of a large and useful body of engineers, and at the desire of several institutions for their instruction, he had set apart a portion of his time for the study of a subject which involved considerations of much importance to the great mass of the community. If he stated that the subject was one easily mastered, or that past experience rendered his task an easy one, he should practise a deception, and arrogate a degree of information and research which he did not profess. The statements he had to make had cost him much time and labour to prepare. In the consideration and preparation of two lectures for the Yorkshire Union Mechanics' Institutions, the subject gained upon him so fast, and became so exceedingly interesting, that he had a strong desire for further research; but at that time, in consequence of other professional duties, he was obliged to abandon the attempt to a more fitting opportunity. During a long and somewhat laborious professional life, however, he had contrived, as a relaxation from labour, to devote a considerable portion of his leisure, and no small portion of the hours of sleep, to scientific inquiries; and, finding it had done him no harm, but rather quickened the intellect by enlarging its sphere of action, he had the less hesitation in recommending this practice, as it would be found productive of enjoyment as well as benefit. In early life he laboured under many difficulties. Their causes he could not control; but experience had convinced him how much might be done by a willing mind, and with what certainty individual perseverance and a never-tiring enthusiasm in one's pursuits would clear away all obstacles, and lead, by the most satisfactory and pleasant paths, to reputation and success. Before determining upon an occupation, or upon a study for the employment of leisure time, he recommended the consideration of what it was desired to attain. Let the object be practical and useful; then bring the whole powers of the mind to bear upon the subject; work hard, and let not energy be thwarted even by the taunts and ridicule of companions and fellow-labourers. Be not discouraged by early failure, nor turned aside by the tedium of mastering the drudgery of rudimentary study. The pleasures and delights of study came with a thorough understanding; and nothing valuable, least of all the treasure of a gifted mind, was to be had without labour. To distinguish between steam generated at different pressures, he traced water in its varied stages of temperature corresponding with its conditions in passing from the solid to the fluid and the vaporous states. Dr. Black discovered that it was not sufficient for converting ice into water that it be raised to a temperature in which it could no longer retain that form, as a piece of ice of the temperature of 32° would remain a very long time in the air at 50°, continually absorbing heat until it melted. By comparing the time at which the ice had its temperature changed from 20° to 32°, he found it absorbed from 130 to 140 times as much heat as would raise its temperature 1°; and he found that 1lb. of ice when mixed with 1lb. of water 140° warmer, was just melted, but without rising in its temperature above 32°. Hence he justly concluded that water differed from ice of the same temperature by containing as a constituent a greater quantity of heat united in such a way as not to quit it for another colder body, and therefore so as not to affect the mercury of the thermometer and expand it. If more heat were added to the water, it was no longer latent, becoming sensible in its effects by raising the thermometer. Water would not boil unless heat be applied to the bottom or sides of the vessel containing it. If the heat were applied to the top of the vessel, the water would evaporate and waste away. When heat was applied to the bottom and sides of a vessel, the particles of water in contact therewith formed into globules, which, being of greatly reduced specific gravity, ascended until the colder stratum on the upper surface robbed them of their heat, and destroyed that elasticity which was necessary for their ascent. The distances they reached before collapsing depended upon the temperature of the fluid; but they continued to rise until the temperature reached 212°, when commotion became general, and boiling ensued. Heat, from its want of ponderosity, was highly elastic; and when enclosed in films of water in the form of globules, its specific gravity and elasticity was many thousand times less than that of water. To a certain extent the particles of heat radiated from a fire in every direction; but it would be found that in open space the tendency was upwards, and that more particularly when imparted to water, when the globules are produced all over the bottom, and make the ascent vertically. Steam was evaporated, and water boiled, at different temperatures, according to the weight of the atmosphere. When the barometer was low, the fluid would boil at a lower temperature, as water, at 30 inches of the barometer, boiled at 212°; at 28 inches, it boiled at 208½°; and upon the plains of Quito, where the air was attenuated and the barometer stood at 21 inches, it boiled at 195°. There was a wide difference between steam generated in an open vessel and in a close one. In the first case, the temperature never exceeded 212°; whereas in the latter, the temperature, as well as the density, elasticity, &c., may be carried to any extent, consistent with the safety or strength of the vessel. This condition should never be lost sight of, as the security of life and property uot unfrequently depended upon the extent of knowledge of the densities and other properties of steam. Data could not be supplied for the construction of vessels calculated to bottle up and retain vaporous matter of highly elastic force, without an acquaintance with the nature of the material, and the agencies to be dealt with. The vapours exhaled from a liquid at any temperature contained, according to Dr. Ure, "more heat than the fluid from which they spring, and they cease to form whenever the supply of heat into the liquid is stopped." This might be perfectly true; but continue to apply the heat, and also the supply of water, and the process of evaporation is continued, with all its accompaniments, as exhibited in the general practice of raising steam. If the temperature of the furnace and the steam or evaporation part of the water contained in the boiler are so nearly adjusted as to be exactly in accordance with the density and quality of the steam produced, there would be throughout the whole process the required equivalents of quantities as regarded temperature, density, and elasticity; but increase or stop the supply of heat, or increase or diminish the extraction of the steam thus generated, and immediately the relations of demand and supply, which previously existed, were changed; and although the relative quantity of heat and density might be retained, there was nevertheless a total change in the force and elasticity of the steam, when compared to that uniformity of the process which maintains a true balance between the expenditure and the supply. The interception of any one of these processes was a matter of the utmost importance, and often resulted in accident. For further information, he referred to his report upon the explosion of a boiler at Longsight, published at the time in the "Guardian." Comte de Pambour said, in his Practical Treatise on the Steam-engine—

"When the steam, after having been formed in a boiler, remains in contact with the generating water, it is observed that the same temperature corresponds invariably with the same pressure, and *vice versâ*. * * * This being the case, it is impossible to increase the temperature without the pressure and density increasing spontaneously at the same time; and it is equally impossible to increase its density or its pressure without increasing its temperature."

It was immaterial how this was accomplished, as the compression of a volume of steam into a small space would increase its temperature in the ratio of its density, and that without the infusion of additional increments of heat. Compression alone was sufficient to effect that object and that upon the same principle as a volume of air could be made red-hot by severe compression. In this state of the relative temperatures to pressure, steam was at its maximum density and pressure for its temperature, and hence followed the connexion which constantly existed between temperature and pressure. In every case where steam is generated, it must be in contact with the liquid in the vessel supplying the steam. Else, if the temperature be augmented, the state of maximum density, according to Pambour, would cease, "since there will be no more water to furnish the surplus of steam or increase of density corresponding to the increase of temperature." Experiments as to the relative temperatures and densities of steam had seldom extended beyond a few atmospheres; most of them had been made below the pressure of the atmosphere. As scientific inquiries they were valuable; but to the practical engineer, having to deal with steam as high as six or seven atmospheres, and when he might be called upon in future to use and economise steam at double that pressure, they were comparatively of little value. The experiments of Arago and Dulong were instituted at the request of the Academy of Sciences of the Institute of France to determine certain data, and they were not of a character to instruct the operative engineer in the elementary truths connected with his pursuits. Here he would notice the difference existing between our Government and that of France. There, if a doubtful question in science had to be determined by experiment, the Government cheerfully undertook it, generally through the medium of the National Institute. Here, it and the expense were left to individuals; and he would not say what he had spent in this way. He was glad to observe a more liberal and generous feeling on the part of our Government, in the grant of £1,000 annually to promote aud extend science. Having instituted a comparison between the results of the experiments of Arago and Dulong, with those of his own experiments at Longsight, he referred to others made by Mr. Ramsbottom, the resident engineer on the north-east division of the London and North-Western Railway, proving that all means of escape for steam, with a blazing or moderate fire under the boiler, could not be closed with impunity. The results of the experiments of Arago and Dulong, and those made by himself, approximated so closely, that they might be safely recommended for adoption in every case where the temperature, density, and volume of steam became a question of consideration for the practical engineer. After quoting Pambour on the relative volume of steam to its equivalent volume of water, he said it appeared to be a universal law, that any increase of pressure was followed by its relative increase of temperature, and that we could not with impunity attempt to force the atoms or molecules of bodies into closer contact, without an equivalent increase of temperature. This he had found amply verified up to a pressure of 6,000 atmospheres or 90,000 lb. on the square inch. According to the experiments of M. Gay Lussac, as given by Pambour, for every augmentation of 1° temperature Fahrenheit, there would be an increase of ·00202 of the volume occupied by the fluid at the temperature zero. This law did not apply to steam in contact with water, as the pressure invariably changed with the temperature, and *vice versâ*. Philosophers differed as to the laws which governed the mechanical action of steam, its loss of temperature, &c., particularly when the steam was in contact with the water in the boiler. Steam, when evaporated from water under the pressure of the atmosphere, never exceeded a temperature of 212° Fahrenheit. Therefore, all the heat given by the furnace to the water must resolve itself into the steam, and must remain there in a latent state, as the additional increments of heat had no effect on the thermometer, and only became perceptible when the steam was condensed and parted with its heat. The transport or conveyance of steam to any distance had invariably been attended with loss, from the escape or radiation of heat given out from the pipes by which the steam is conducted in its passage to the engine, or to the spot where it might be used, either as a motive force, or for the purposes of heating, boiling, &c. Deprived of a portion of its caloric, it then became steam of a different description to what it was when in contact with the liquid in the boiler, and when it was receiving constant supplies of heat from the furnace. Once admitted into the pipes, that contact with the fluid so essential to the maintenance of its temperature and density no longer existed; and, without care, a considerable portion of its heat, and along with it the pressure, would inevitably escape. This was a question of great importance to every one connected with the procreation and use of steam; and he could not sufficiently impress upon the minds of engineers, operative and professional, the necessity for instituting a careful inspection into all the requirements of clothing pipes and boilers to prevent condensation and the disengagement of that subtle fluid, heat. Under all circumstances, special attention should be paid to the retention of heat, whether latent or otherwise, in contact with the steam, and that by carefully clothing the exterior surface of pipes and boilers exposed to the atmosphere. Heat was one of those insidious, sly, deceitful agents, that was constantly on the watch to make its escape. It resisted every attempt to place it under control; and it not unfrequently happened that the strongest iron plates and bars were insufficient to resist the force and impetuosity of its attack. When allied with the vapour of water, it gathered strength by confinement: therefore, in the exercise of an economical distribution of steam, as a motive power, care should be taken to maintain the union of heat and water. To produce a maximum mechanical effect with a minimum quantity of steam, it was necessary to prevent the escape of heat in its transmission from the boiler to the engine, and to work it expansively when there. A great deal had been said of surcharged steam—steam re-heated in its passage from the boiler to the engine; and though not so well acquainted on this subject as he could wish, he had suspended steam-pipes in heated flues; and he had not only found the plan economical, but preventive of condensation, conveying to the engine what was technically called dry steam. It was further desirable to make use of the surplus heat for increasing the temperature of the water from the feed-pump by enclosing those pipes also in the flues, or by exposing a series of pipes to the action of the heated currents as they pass from the boiler to the chimney—a method already adopted successfully by means of apparatus constructed by Mr. Smith, of Oldham. It was now generally acknowledged that a considerable saving was effected by the expansive action of steam, independent of what was accomplished by the improved methods recommended for the generation and maintenance of the temperature and the density of the steam in the boiler and its passage to the engine. To effect this with increased economy, high steam must be used and applied with a sound discretion, not only as a principle of economical working, but as a measure of safety, either as regarded its consumption, the strength of the boiler, or the different organic parts of the engine exposed to its influences. Among the ingenious devices to effect this object, there was Woolf's system of the double cylinder, the cut-off principle in the single cylinder, besides other methods which had been more or less successful. All these, however, tended to the same result; and whatever the mechanical arrangement, the ultimate tendency was to economise fuel by the introduction of a highly elastic force upon the piston of the reciprocating engine, in the first instance; and that, having overcome the *vis inertia* of the load, gave the impetus of motion immediately, as the piston passed from a state of rest to a state of motion at the return of the stroke. In this way the communication between the boiler and the cylinder was cut off at the required point; and the further motion of the piston was continued by the force of the expanding steam to the end of the stroke. In this way the motion of the engine was continued, and that with greatly increased economy in the use and application of the steam. In conclusion, he requested them to reflect upon the matters he had laid before them; and he trusted that he was not too sanguine in hoping that he had impressed them with his own conviction, that the wide-spreading of sound principles and enlarged views in practical science would not only be useful to themselves, in the pursuit of their separate avocations, but advantageous to every class in the community of which nations are composed.

Mr. William Fairbairn, C.E., F.R.S., delivered the second of two lectures at the Mechanics' Institution, of which he is a vice-president, on Wednesday, March 7th; the subject of the latter being "The strength and form of vessels calculated to insure safety, and resist the elastic force of steam; the relative proportion of flue to furnace surface in boilers; and the relative value of high and low steam."

Mr. Fairbairn, who was received with applause, after arranging the subject under suitable heads, said that at one time copper, earthenware, and other substances, were used for boiling vessels. It was discovered, in 1686, by Dr. Hook, that the temperature of boiling water remained fixed, and subsequently Dr. Pepin made the elastic force of confined steam more familiar. Combining this with condensation, Captain Savery applied the power to an engine for raising water; and his boiler (the first, properly speaking) was made of and rivetted with copper, which, though a better conductor of heat than iron, was more expensive, rendering it probable that iron plates were used before the introduction of Newcomen's improvements. Cast-iron plates were superseded by those of malleable iron; but copper continued to be used, particularly for the fire-boxes of locomotives, for which it was preferable to iron. Almost from the first, Mr. Watt used wrought-iron; and he discovered that the longitudinal or waggon-shaped boiler was preferable to that of the "haycock" shape, used by Newcomen and Beighton. Hornblower, Woolf, and others adopted the cylindrical form, similar to those so long used in Cornwall and elsewhere, where steam of greater density and pressure was employed. A boiler was subjected to two strains—tension, which tended to tear or rip up the outer shell; and compression, which would crush or collapse the internal flues or tubes. These were to be resisted, and that with a maximum effect; and there was a great difference between the resistance to each strain of the metals whose strength per square inch compared as follows, the figures representing tons:—

	Tension.	Compression.
Wrought-iron plates	23	12
Copper plates	16	3
Cast-iron plates	8	51

Hence, it was important, in construction, to employ that metal which was the most eligible, when the nature of the strain was considered. Watt's discoveries rendered steam of high density unnecessary, when the required forces could be obtained without risk to the boiler; but now, increased power being required, it was obtained by increased pressure, with boilers of improved form and strength. Before the use of high steam, strength was not so important as form. Watt's waggon-shaped boiler had reference to a large heating surface, and those parts liable to bulge outward were held together by iron stay-rods. The advantages of high steam, worked expansively, were early discussed; and both high and low steam were used in the mining districts: but it was only within the last ten or twelve years that manufacturers in this country had appreciated high steam, owing to the increase of manufactures and the unequal increase in the price of coal. It was used earlier on the Continent and in America. In combating the objections against it many years ago, he demonstrated its saving of fuel and increase of power. With it the double-cylinder engine was preferable for regularity of motion, but it did not save more fuel. The irregularity of the single engine was of less importance than many imagined, and was easily remedied by increasing the weight of the fly-wheel, and neutralising the irregularities of the stroke of the piston by velocity. Two engines might be worked together at right angles without these irregularities, and with perfect safety, through the whole range of expansive action. Therefore, he recommended the single engine. It was less expensive, equally efficacious, and, perhaps, more economical than a machine of greater complexity. Considering the facts already stated, we must look forward to the use of a greatly increased, instead of a reduced, pressure of steam. So convinced was he of the advantages of high steam worked expansively, that he urged preparation for greatly increased progress. It must be obvious that steam generated under pressure, compressed into one-fifth or one-sixth the space it formerly occupied, and again, applied to an engine of little more than one-tenth the bulk, must be a desideratum in the appliance of steam. The force applied to one of the largest of locomotive engines, travelled with a train at the rate of 45 miles an hour, exceeded 700 horses power; and there was no reason why factories should not be driven, and the largest ships propelled, by such engines, with greatly increased economy by well-directed condensation. Soon, this would be more extensively accomplished than might now be considered possible or safe, and space would be lessened and power doubled with greatly increased economy and effect. He and another gentleman had been in communication with the Admiralty respecting the introduction of high-pressure steam upon the same principle as used on the railways; and he was satisfied that, if properly applied, it would effect an important saving in steam navigation. The cylindrical or spherical was the most eligible and the strongest form in which iron plates would resist internal pressure. The deduction for loss of strength on account of rivetted joints, and the position of the plates, was about 30 per cent. for the double-rivetted joints, and 44 per cent. for the single ones; the strengths (calling the plates 100) being in the ratio of 100, 70, and 56. He found that 34,000 lbs. to the square inch was the ultimate strength of boilers having their joints crossed and soundly rivetted. Flat surfaces, frequently essential, were not so objectionable with respect to strength as they appeared to be at first sight; but, when properly stayed, were the strongest part of the construction. This was proved by the result of experiments made on the occasion of the bursting of a boiler at Longsight. Two thin boxes, 22 inches square and 3 inches deep, were constructed. One corresponded in every respect to the sides of the fire-box of the exploded boiler, the stays being in squares, 5 inches asunder, and the side containing 16 squares of 25 in. area. The other contained 25 squares of 16 in. area, the stays being 4 in. asunder. One side of both boxes was a copper plate ½ inch thick, and the other side of both an iron plate ⅜ inch thick. To these the same valve, lever, and weight were attached, and the pumps of an hydraulic press applied. That divided into squares of 25 inches area swelled ·03 inch with the 8th experiment, at a pressure of 455 lbs. to the square inch. At the 19th experiment, with a pressure of 785 lbs. to the square inch, the sides swelled ·08 inch; and at a pressure of 815 lbs. the box burst by the drawing of the head of one of the stays through the copper, which, from its ductility, offered less resistance to pressure in that part where the stay was inserted. The 10th experiment with the other box of 16-inch areas resulted in a swelling of ·04 inch, the pressure being 515 lbs. to the square inch. At 965 lbs. the swelling was ·08 inch, and from that point up to 1,265 lbs. the bulging was inappreciable. With the 47th experiment, at a pressure of 1,625 lbs., one of the stays was drawn through the iron plate, after sustaining the pressure upwards of 1½ minutes, the swelling at 1,595 lbs. having been ·34 inch. The first series of experiments proved the superior strength of the flat surfaces of a locomotive fire-box, as compared with the top or even the cylindrical part of the boiler. The latter evidenced an enormous resisting power, much greater than could be attained in any other part of the boiler, however good the construction; and they showed that the weakest part of the box was not in the copper, but in the iron plates, which gave way by stripping or tearing asunder the threads or screws in part of the iron plate. According to the mathematical theory, the strength of the second plate would have been 1,273 lbs.; but it sustained 1,625 lbs., showing an excess of one-fourth above that indicated by the law, and that strength decreased in a higher ratio than the increase of space between the stays. The experiments show a close analogy as respects the strengths of the stays when screwed into the plates, whether of copper or iron; and rivetting added nearly 14 per cent. to the strength which the simple screw afforded. These experiments were conducted at a temperature not exceeding 50° Fahrenheit. His experiments on the effects of temperature on cast-iron did not indicate much loss of strength up to a temperature of 600°; and he concluded that the resisting stays and plates of locomotive boilers were not seriously affected by the increased temperature to which they were subjected in a regular course of working. The subject was entitled to further consideration. In boilers it was necessary to preserve a large margin strength as regarded the working pressure and the ultimate power of resistance. Six or seven times the working power was not too much to provide for contingencies. With respect to the proportion or relative values of the furnace to the other absorbent surfaces, as recipients of heat, there was great diversity of opinion, as much depended upon the quality of the fuel used, and the rate at which it was consumed. There was no fixed rule as to the proportion of the dimensiou of the grate-bars to that of the surface of the boiler exposed to the action of heat; and a series of well-conducted experiments on these points was much wanted, to determine also the quantity of heat absorbed by the surfaces surrounding the furnace, and at different distances, as these surfaces receded from the immediate source of heat. Fourteen or fifteen years ago, he found the mean of 15 boilers to be nearly as 1 for the grate-bar surface, to 11 recipient or heating surface. This was approximately correct, and appeared to be in use for obtaining the best results; but he had doubts as to its accuracy, as it was formed upon no fixed law. Time was an element which could not be neglected in the combustion of a certain quantity of fuel, and hence we had slow, active, and "excited" combustion. The first was practised generally in Cornwall, where the draught was kept down by the damper, and the heated currents made two or three circuits of the boiler at a slow rate, thus affording time for the absorption of heat during its passage to the chimney. Stationary boilers received every description of treatment, in all its gradations from slow to active combustiou, arising from the want of space, or the want of money, or of the inclination to spend it in the construction of new boilers; and combustion was sometimes carried on with such determined energy as to cause an euormous waste of fuel, expensive as regarded wear, and productive of smoke. The marine boiler admitted of no alternative, and the combustion must be active owing to the small space allotted to the boiler; but much might be done to economise fuel, by increasing the areas of the recipient surfaces, which was best accomplished by the tubular system, and a wide diffusion of the increments of heat as they passed from the furnace through the tubes, and thence to the water in the boiler. Excited combustion applied almost exclusively to locomotive engines. The boiler was similar to the multitubular; but whilst, in oue, the fire was supplied with oxygen by the rarefied draught of the chimney, in the other it was excited with much greater intensity by the blast of the steam passing from the cylinders at great velocity into the chimney. The steam operated upon the smoke-box behind, and through the tubes to the furnace, like a pump, and rapid currents of cold air blew up the furnace when the engine was in motion; therefore, "the faster she goes, the harder she blows"—(laughter),—and at high speed such an engine had all the properties of the blow-pipe, in exciting and maintaining an intensity of heat in the furnace almost sufficient to melt the hardest metals, producing a white heat, which would soon destroy the fire-box, but for the great difference between its temperature and the water in the boiler, which seldom if ever exceeded 400°, that of the furnace being probably as high as from 1,500° to 2,000°. Owing to this intense heat, the furnace had to be surrounded with material such as copper, of high conducting powers, and other recipient surfaces, such as the tube. These required to be as thin as possible, to save time in the transmission of heat, and to effect a rapid evaporation from the water contained in the boiler. The difference, therefore, between locomotive and other boilers was, that time was of more importance, as the locomotive would raise as much steam in one hour as a stationary or marine engine boiler would raise in twenty; the former requiring 15 square feet of fire-bars, and the latter 300 square feet, being in the proportion of 1 to 20. The subject deserved careful investigation, and we might reasonably hope to gain advantage from a principle only partially developed as yet. Safety-valves had occupied much attention; but the projects put forward, though exceedingly ingenious, were not self-acting and free from risk. There were nearly twenty different ways of feeding a boiler. In Watt's days, a pump supplied a cistern 10 or 12 feet above the boiler, which height measured the pressure of steam within. Now, the altitude of a column of water must be measured by the height of the chimney, which was too expensive and inconvenient for high-pressure steam. The only alternative was a pump powerful enough to overcome the resistance of the steam, and to regulate the supply in such a way by the admission-valves, as would cover the flues and maintain the water at a fixed and uniform height. This was accomplished in several ways, with appendages which, though not necessary, did no harm if kept clean and in working order. Working steam expansively was one of the most important subjects to which the engineer could direct his attention. The differeuce between high and low steam was the measure of elasticity and temperature, wheu taken at the extremes at which it is worked, from 10 lbs. to 150 lbs. on the square inch. When the steam impinges upon the piston at 10 lbs., it follows up the supply and pressure continually throughout the whole length of the stroke, or nearly so; but steam of greater density, instead of pressing upon the piston with a coutiuuous flow, had its communication with the boiler intercepted at a particular point of the stroke, and the steam thus cut off was left to perform the remaining portion of the stroke by its own initial or elastic force, dilating or expanding as the piston moved. This was the theory of what was technically called working steam expansively. There were no calculations founded upon experimental facts respecting the value of the system. He, however, demonstrated that, with an engine of six-feet stroke, cylinder 40 inches diameter, and cutting off the steam (40 lb. on the square inch) at one-sixth of the stroke, it did rather more than one-half the duty with one-sixth the quauity of steam that would otherwise be used, or above three times the work. It was important to attend to the perfect combustion of fuel, and the transmission as well as the retention of heat, as it was evolved in the process, and also to maintain cleanliuess and order about a steam-engine and a boiler. In a well-managed concern, safety-valves and feed-pumps were not allowed to continue out of repair, and there was no tampering with such vital organs of safety. Everything was in its place, and was kept in the most perfect order, well oiled and well cleaned, so as to be at all times ready for service. With respect to the steam-engine also, the same regularity and system of management was preserved; and the result was a beautiful piece of machinery working with a degree of precisiou at once the admiration of the employer and the pride of the engineer. He would have all the engines kept in this style. Hence the advantage of polished surfaces and the mathematical exactitude with which the steam-engines of the present day were executed. A well-constructed machine, neatly executed, had a wonderful effect upon the mind of its keeper. It only required a few months to accustom him to habits of cleanliness and order; and it improved his taste and elevated his mind to see his pet engine, with the arms of a giant, finely polished, overcoming the resistance of a thousand horses, and impelling with the same apparent ease a floating citadel or a pouderous train. In conclusion, he would quote the words of a distinguished writer, who, in speaking of the steam-engine, said—

"It is stupendous alike for its force and flexibility—for the prodigious power which it can exercise, and the ease, and precision, and ductility with which it can be varied, distributed, and applied. The trunk of the elephant, that can pick up a pin or rend an oak, is nothing to it. It can engrave a seal, or crush masses of obdurate metal like wax before it; draw out, without breaking, a thread as fine as gossamer; and lift a ship of war like a bauble in the air. It can embroider, forge anchors, cut steel into ribbons, and impel loaded vessels against the fury of the waves."

It could do all this, and more, since the eulogium quoted was pronounced; and he looked forward to the time when still greater impossibilities would be effected in the action of the steam-engine and the use of steam.—(Loud and continued applause.)

ROYAL SCOTTISH SOCIETY OF ARTS.

A Short Sketch of the Rise and Progress of the Royal Steam Navy, with a few Practical Suggestions growing out of fourteen years' experience in Her Majesty's Service. By Mr. JAMES SPENCE, Chief Foreman of the Steam Factory at Portsmouth Dockyard.—After giving a view of the rise and progress of the Royal Steam Navy of Great Britain, the author gave a summary of what he had before proved (by giving the names, guns, and tonnage of each ship), and concluded as follows:—In briefly recapitulating the leading facts, he stated that it would be found that in 1840 the Royal Steam Navy consisted of between thirty-eight and fifty vessels (paddle-wheel), of all classes; that in 1845, when the Queen reviewed the Chanuel Fleet, the *steam* branch was on that occasion represented by one solitary ship, the *Rattler*; that in 1853, when the Queen again reviewed the fleet at Spithead, the steam branch had increased to twenty-seven paddle-wheel vessels and thirteen screws, while there were only three sailing ships present. It was also remarked, that when it was seen that the country was actually to be engaged in war, the exertions of the Admiralty had been on the grandest scale, and worthy of the greatest maritime nation of the world; and he gave the following table to show the present strength of this arm of the public service, being a summary of the Baltic and Black Sea Fleets:—

SUMMARY OF THE BALTIC FLEET, SEPTEMBER 1854.

	Ships.	Guns.	Horse Power.	Tons.
The Screw Fleet............	28	1,636	10,702	58,550
The Paddle do..............	23	169	7,580	20,702
The Sailing do..............	4	400	——	10,600
Grand Total..........	55	2,205	18,282	89,852

SUMMARY OF THE BLACK SEA FLEET, SEPTEMBER 1854.

	Ships.	Guns.	Horse Power.	Tons.
The Screw Fleet............	10	277	3,020	14,869
The Paddle do............	18	129	6,622	18,695
The Sailing do............	12	933	——	——
Grand Total..........	40	1,339	9,642	——

On a New Form of the Platometer; an Instrument for ascertaining the Area of Plane Surfaces. By James Clerk Maxwell, Esq., Trinity College, Cambridge.—Drawings of the instrument were exhibited.—The author stated that the name of platometers, or planimeters, has been given to instruments which by a mechanical contrivance measure the superficial contents of any area round which a tracing point connected with the instrument is made to pass. In all those hitherto constructed, the essential part of the instrument has consisted of a wheel, which is turned by the friction of another revolving body connected with the instrument, the radii of which are unequal; and the change of position of this wheel is effected by a lateral slipping along the surface of this body. Now, it might be shown mathematically from the laws of friction, and confirmed by the simplest experiments, that though the friction is sufficient to insure perfect rolling when there is no lateral sliding, yet, when such lateral sliding takes place, the very slightest disturbing force produces a deviation from the result of perfect rolling, the amount of which depends on the amount of this disturbing force, and on the distance over which the lateral dragging takes place. Mr. John Sang, in a paper in the Transactions of this Society, has explained this effect, and shown how to measure and correct it. The instrument described by the author was stated to be the result of an attempt to do away with slipping altogether, and as far as the theory goes it is perfectly successful. The working parts of the instrument consist of a hemisphere revolving round a horizontal axis, and a sphere mounted on a framework, so that its axis remains always horizontal, but changes in position, so as to admit of different points of the sphere and hemisphere coming in contact. The radii of these two surfaces are equal, and the framework is arranged so as to keep them always in contact, in such a way that while the ratio of their velocities of rotation changes according to the position of the tracing point, the action between the points in contact is always that of perfect rolling, without the possibility of slipping. In this way, it is presumed that a necessary source of error in all former instruments has been disposed of, and the instrument rendered mathematically perfect. Whether the actual construction of the instrument will be more or less difficult than that of those already made, and whether other inconveniences belonging to the peculiarities of the parts may interfere with its working, are questions for practical men to decide. It is thrown out by the author, partly as a suggestion to instrument-makers, and partly as an addition to the theory of a class of instruments which, for the ingenuity of their construction and the accuracy of the performance of those already made, deserve more attention than they have hitherto received.

On Writing Inks. By James Stark, M.D., F.R.S.E.—The inks were exhibited.—The author stated that in 1842 he had commenced a series of experiments on writing inks, and up to this date had manufactured 229 different inks, and tested the durability of writings made with these on all kinds of paper. As the result of his experiments, he showed that the browning and fading of inks resulted from many causes, but in ordinary inks chiefly from the iron becoming peroxygenated and separating as a heavy precipitate. Many inks, therefore, when fresh made, yielded durable writings; but when the ink became old, the tannogallate of iron separated, and the durability of the ink was destroyed. From a numerous series of experiments, the author showed that no salt of iron and no preparation of iron equalled the common sulphate of iron—that is, the commercial copperas—for the purpose of ink-making, and that even the addition of any persalt, such as the nitrate or chloride of iron, though it improved the present colour of the ink, deteriorated its durability. The author failed to procure a persistent black ink from manganese, or other metal or metallic salt. The author exhibited a series of eighteen inks which had either been made with metallic iron or with which metallic iron had been immersed, and directed attention to the fact that though the depth and body of colour seemed to be deepened, yet in every case the durability of writings made with such inks was so impaired that they became brown and faded in a few months. The most permanent ordinary inks were shown to be composed of the best blue gall-nuts with copperas and gum, and the proportions found on experiment to yield the most persistent black were six parts of best blue galls to four parts of copperas. Writings made with such an ink stood exposure to sun and air for twelve months without exhibiting any change of colour; while those made with inks of every other proportion or composition had more or less of their colour discharged when similarly tested. This ink, therefore, if kept from moulding and from depositing its tannogallate of iron, would afford writings perfectly durable. It was shown that no gall and logwood ink was equal to the pure gall ink in so far as durability in the writings was concerned. All such inks lost their colour and faded sooner than pure gall inks, and several inks were exhibited which, though durable before the addition of logwood, faded rapidly after logwood was added to them. Sugar was shown to have an especially hurtful action on the durability of inks containing logwood—indeed, on all inks. Many other plain inks were exhibited, and their properties described—as gallo-sumach ink, myrobalans ink, Range's ink—inks in which the tannogallate of iron was kept in solution by nitric, muriatic, sulphuric and other acids, or by oxalate of potash, chloride of lime, &c. The myrobalans ink was recommended as an ink of some promise for durability, and as the cheapest ink it was possible to manufacture. All ordinary inks, however, were shown to have certain drawbacks, and the author endeavoured to ascertain by experiment whether other dark substances could be added to inks to impart greater durability to writings made with them, and at the same time prevent those chemical changes which were the cause of ordinary inks fading. After experimenting with various substances, and, among others, with Prussian blue and indigo dissolved in various ways, he found the sulphate of indigo to fulfil all the required conditions, and, when added in the proper proportion to a tannogallate ink, it yielded an ink which is agreeable to write with, which flows freely from the pen, and does not clog it—which never moulds—which, when it dries on the paper, becomes of an intense pure black, and which does not fade or change its colour, however long kept. The author pointed out the proper proportions for securing these properties, and showed that the smallest quantity of the sulphate of indigo which could be used for this purpose was eight ounces for every gallon of ink. The author stated that the ink he preferred for his own use was composed of twelve ounces of galls, eight ounces of sulphate of indigo, eight ounces of copperas, a few cloves, and four or six ounces of gum-arabic, for a gallon of ink. It was shown that immersing iron wire or filings in these inks destroyed their durability as much as similar treatment destroyed ordinary inks. He therefore recommended that *all legal deeds or documents should be written with quill pens*, as the contact of steel invariably destroys more or less the durability of every ink. The author concluded his paper with a few remarks on copying inks and indelible inks, showing that a good copying ink has yet to be sought for, and that indelible inks, which will resist the pencillings and washings of the chemist and the forger, need never be looked for. After some discussion on the importance of the subject treated of in this paper, in which Messrs. Elliot, Turnbull, Pattison, Beatson Bell, J. F. Macfarlan, and the Secretary took part, the paper was referred to a Committee for their report.

Description and Drawing of a Railway Lighthouse Signal. By Andrew Carrick, Esq., 14, Holmhead-street, Glasgow.—This signal is a stationary, clear light, placed at the beginning of any tunnel or curve, or near to a junction. Every passing engine changes the light to a *red colour*, which disappears gradually in ten minutes. The smallest glimpse of red light will caution the conductor of any approaching train that there is danger of running into another train not far in advance. The proximity of the latter to the lighthouse may be estimated from the perpendicular degree of red light observable.

Remarks on the Strength of Screw-Blades, with Drawings; and Description of an Instrument for measuring the Pitch and proving the correct Form of Screw-Propellers, called a Pitch-Compass, with Drawings. By Mr. James Spence, Chief Foreman of the Steam Factory of H.M. Dockyard, Portsmouth.—The author stated that the form, length, diameter, and area of the screw had all been carefully examined and experimented on, and well-authenticated data recorded; but he was not aware that so much attention had been paid to the *strength* of the screw-blade. Hence we are frequently hearing of accidents from breakage. The author remarks that in all the broken screws they have had in the navy, the fractures have taken place at about one-third of the length of the blade from the boss. The *Duke of Wellington's*, the *Phœnix's*, and Sir Thomas Mitchell's Boomerang all broke at about this point. Hence the peculiar converse form of the blade should be carried well out beyond one-third of the length of the blade. The author then went on to describe a very useful instrument, called a pitch-compass, for measuring the pitch and proving the correctness of the form of screw-propellers. This machine was suggested by Mr. Rawson, head master of the School of Shipwright Apprentices at the dockyard. A chuck provides a centre pivot in the exact line of the axis of the screw. A trammel, made in two pieces, for strength and convenience, is filled with two trap bushes, having holes made to fit on the centre spindle of the chuck. It therefore forms a correct moveable base line at right angles to the axis of the screw. The circular plate on the chuck is divided into twelfths of the circumference; that is, the holes in it are thirty degrees apart. The trammel being secured in one of these holes, a measurement is taken from the trammel, as the base line, to the screw-blade by means of a moveable pointed rod at right angles to the trammel, and capable of being moved along the trammel as the length of the blade increases. The trammel is then moved to the next hole in the circular plate of the chuck, and secured, it having passed through thirty degrees. A second measurement is then taken from the trammel to the screw-blade, when the difference in inches between the first and second measurement will be equal to the whole pitch in feet, and so on; so that by indicating the commencement and end of the measurement, by rings clamped on the moveable pointed rod, and measuring the alternate distances between them in inches, we get the whole pitch of the screw in feet.

CORRESPONDENCE.

MUNTZ'S PATENT METAL.

To the Editor of The Artizan.

Sir,—I think, if Mr. Muntz, jun., had given some arguments in favour of his assertions, it would have been more serviceable to your readers than his intemperate letter in your last Journal. Without making the question a personal one between us, I must state that I have no knowledge whatever of Mr. Armstrong; and as far as the yellow metal is concerned, I deny that I am "*at sea*." The metal to which I alluded is yellow metal, which has been "*at sea*;" and I have seen it frequently, precisely as described in your last Journal in "Notes by a Practical Chemist," completely disintegrated, and, as I believe, from the oxidation of a portion of the zinc. What Mr. Muntz means "*by the metal made of anything by everybody, and an imperfect and less valuable imitation*," I leave your readers to solve, and will merely state who are the firms (besides Mr. Muntz) manufacturing yellow metal sheathing and bolts,—viz., Messrs. Williams, Foster, and Co.; Messrs. Vivian and Sons; Messrs.

Sims, Willyams, Nevill, and Co.; and Messrs. Pascoe Grenfell and Sons; firms of the highest respectability, and whose manufacture of yellow metal is (as I think Mr. Muntz must admit) not inferior to his own: though, from his letter, the public are to believe that Mr. Muntz's metal must be, like a Brussels carpet once sold by a country auctioneer, "a genuine article, because it was made by Mr. Brussels himself." The questions which have been raised will not be solved by letters such as Mr. Muntz's last, and I shall be glad to see in your Journal (of which I am a constant reader) the results of trials and experiments which many of your correspondents can furnish. I sign myself again *in propriâ personâ*,

A Brassfounder.

Birmingham, 17*th March*.

The following letters have appeared in the *Mining Journal*.—Ed. Artizan.

MUNTZ'S PATENT METAL.

Sir,—You probably have noticed some letters which have appeared in The Artizan lately, condemning the use of yellow metal; and it is, no doubt, a puzzling question to most of your readers,—why it is that, after a test of upwards of twenty years (which has resulted in the adoption of this metal, not only by all British shipowners, but by nearly all the shipping interest in the world), within the last month it is condemned by one or two individuals as a worthless article?

Three years since, I took out a patent for manufacturing tubes of this metal for boiler flues, and trials were made by the Lords Commissioners of the Admiralty, the London and North-Western Railway Company, and most of the engineers and railway companies in the kingdom, the result of which is, that the tubes have been (within the last four months) put into general use by the Admiralty. The London and North-Western Railway Company, after taking some tubes out of the boilers, and carefully examining them, at once entered into a contract with me to take all the tubes they consume; and other trials having shown similar results, have led to the use of the yellow metal tube in preference to ordinary brass. The yellow metal tube can be made and sold at least 1d. per lb. under the common brass tube: hence it is that on the success or failure of it depends the existence of the brass-tube maker. It is, therefore, evident that the unscrupulous will not be particular as to the means to which they resort to prevent public opinion gaining ground in favour of the yellow metal.

There are, no doubt, large quantities of spurious material offered in the market as yellow metal, which in no way resembles the genuine article but in colour and name, and which is valueless except to those who can sell it, having no reputation, as manufacturers, at stake. It is clear that this is what is described as a drug in the Birmingham market, for genuine old yellow metal is always worth within 1½d. per lb. as much as new; and I am quite ready to give new sheets for any quantity of such old ones at that rate.

The superior qualities which yellow metal has over every other, as regards durability and strength, are so well known to all the shipping interest, that I should not have considered that the remarks of the correspondent of your contemporary required notice; but, as they may not be so well known to the consumers of tubes for locomotive purposes, I shall be glad if you will bring the subject before them, so that they may not be misled as to the real merits of the genuine article.

French Walls, Birmingham, Feb. 27. G. F. Muntz, Jun.

Sir,—In your Journal of Saturday appears a letter from Mr. G. F. Muntz, jun., which is more of an advertising puff in favour of his patent yellow metal tubes, than an answer to the opinions which have been given in The Artizan Journal upon the chemical change observable in old yellow metal sheathing. Will Mr. Muntz kindly inform the public who are the makers, "having no reputation, of large quantities of the spurious material offered in the market as yellow metal?" Surely, each and all of them have a character to vindicate, and will not submit to Mr. Muntz's imperious condemnation. Whether Mr. Muntz's *own genuine* old yellow metal sheathing is *intrinsically* worth within 1½d. per lb. of the price of new, or 10½d. per lb., I leave your readers to decide, and feel convinced that if Mr. Muntz and the *spurious manufacturers* did not give regularly this established price, so much beyond its real value, that the consumption of yellow metal would rapidly decline, and be superseded by copper, which, when stripped from the ships' bottoms, has not wholly lost its ductility, and always finds a ready sale at its actual value, while every shipowner knows that he can scarcely dispose of old yellow metal at half the price of new. With the opinions urged by the "Practical Chemist," in The Artizan, I am disposed to coincide, having frequently seen the old yellow metal completely disintegrated, or quite brittle, and am inclined to believe the Chemist's theory to be correct—that galvanic action takes place between the copper and zinc, and that the proportion of the latter metal becomes reduced. Mr. Muntz passes over these opinions, no doubt finding them difficult to refute, and enters the lists with all his competitors, endeavouring to throw the whole onus upon them. It is needless to disprove this unjust accusation; for, in public esteem, they all stand alike, and can obtain the same price for their sheathing and bolts as Mr. Muntz himself.

With regard to Mr. Muntz's yellow metal tubes, I believe engineers generally do not estimate their advantages as highly as Mr. Muntz. I attach no value whatever to their adoption for a short period by the London and North-Western Railway, for it is well known that this company have, on many occasions, been amongst the first to experiment upon other articles besides tubes, which have proved miserable failures. Let Mr. Muntz wait until he can show a mileage return of 100,000 or 150,000 miles run by a set, before he ventures to dictate their superiority to the public.

March 8. Fair Play.

MUNTZ METAL FOR BOLTS.

(From the "Scientific American.")

I feel much interested in the article in the last week's "Scientific American," in relation to the use of Muntz metal,* or compounds of copper and zinc for sheathing and bolting of vessels; having on several occasions noticed the deterioration of tenacity in brass rods, wires, &c., after being in use for considerable periods of time. Mr. Armstrong attributes the decay to electrical action, induced when Muntz metal or brass is exposed to the action of sea-water, as the altered appearance of the metal sufficiently indicates: its nature seemed to be quite changed, having more the appearance of brown earthenware than brass. In the cases in which I have noticed the decay of tenacity in brass, the metal was exposed to the air, or at most to fresh water, and the metal in each instance had become crystalline, retaining, however, its metallic appearance. This change appeared to be due to irregularity of strain exerted on the brass, it having been long subjected to sudden, alternating, or jerking strains in the direction of its length. Sudden strains or concussions in the direction of length tend to draw the molecules of brass apart, and perhaps, after a time, separate them beyond the sphere of their mutual attraction, and so impair the tenacity of brass wire bars, &c.

To test the truth or probability of the foregoing, the following experiment was tried:—About six years since, my office-bell was removed to the dwelling, about one hundred feet distant, and about eighty feet of very stout and good brass wire was joined to the end of the copper bell-wire attached to the handle, the brass wire passed through the yard for forty feet, then through a shed for twenty feet, and through another yard to the house, where the bell was hung. There were six bell-cranks used for turning angles; and when the whole was finished, it required a pretty strong pull to ring the bell in the house. All answered very well for about five months, when the brass wire broke. With some difficulty, owing to the now brittle state of the brass wire, it was mended; and after a few more breaks and repairs, the greater part of the wire fell to the ground, and the whole of it became brittle, breaking when an attempt was made to bend it. The remnant of brass wire not used remained as good as at first. Small portions of the brittle wire were examined, and found to retain their tenacity in the direction of the diameter of the wire.

The instances in which this decay of tenacity was noticed, was in wire-drawn brass; or perhaps it had been passed through a grooved roller: this is a subject worthy of a thorough investigation. In the above experiment, the brass circular rims of the bell-cranks were less stout than the brass wire, and were subjected to the same straining as the wire, yet they remained uninjured. Now, if the Muntz metal bolts are made by rolling or drawing through die-plates, will not this latent predisposition to weakness in wire-drawn brass cause the bolts soon to lose their tenacity, without any reference to the electrical action of sea-water on the bolts? The sea-water would probably act as a powerful accelerating force to help to destroy the tenacity of the brass bolts. It is not pretended that wire-drawn brass, when used for regular and gentle strains, amounting to a small fraction of the strength of the metal, will be seriously injured in any reasonable time. What is meant is, that brass bolts so prepared are probably unsafe, and that when subjected to the severe and uncertain straining they would be exposed to in ships, in foul weather, would soon become weak and useless. J. T.

[This is very useful information on this subject. Armstrong also pointed out the deterioration in the sheathing of ships, and his inference was a very plausible one, namely, an electric action.—Ed. Sci. Am.]

---

* Extracted from The Artizan.

ON THE IRON INDUSTRY OF THE UNITED STATES.

By Professor John Wilson, F.R.S.E.*

The paper which I have been invited to read before this Society fortunately needs but few words from me by way of introduction. Its title, "The Iron Industry of the United States," secures for it a twofold consideration here;—the one, natural to every country whose power has been increased, and whose wealth and general prosperity have been advanced, by the development of its iron-making resources; the other, natural to this country, whose relations, both social and industrial, are so identified with those of the United States, as ever to excite a lively interest in all the questions which affect their commercial prosperity: and few questions can exert a more mighty influence on the destinies of a country than the possession of the two minerals, iron and coal—the backbones of industry, and the basis of all commercial prosperity.

It is unnecessary to occupy your time with more than a brief sketch of the past history of the iron industry of the States. It contains the usual fluctuations attendant upon the establishment of a new industry, with periods of prosperity and of adversity, induced by fiscal as well as commercial agencies. Iron appears to have been first made in Virginia about the year 1715, previous to which the colony was supplied from the mother-country; and, shortly after, the manufacture was established in the States of Maryland and Pennsylvania. In 1738, we have the evidence of some progress having been made, in the shape of a Report from the officers of the dockyard at Woolwich to the Navy Board, dated September 3 :—

"We have lately received from his Majesty's yard at Deptford, bar iron flats of 2¼ in. broad by ½ in. thick, 15 cwt. 0 qr. 24 lbs.; squares of ⅞ in., 5 cwt. 0 qr. 12 lbs.—imported by Mrs. Cowley from America ; and, pursuant to your warrant of 11th July, 1735, have made sufficient trial of each of the sorts; find the said iron to be very good and fit for H.M. service, superior in every respect to the best Swedes iron, and, in our opinion, worth £17 10s. 6d. per ton."

The manufacture progressed but slowly, though the quantity exported exhibits a regular increase, averaging during the 10 years from 1740 to 1750 about 2,360 tons per annum, which was gradually increased for the next 20 years, until in 1770 it reached 7,525 tons, being rather more than one-sixth of the entire quantity of all kinds of iron imported into England at that time. As the country settled down after successfully asserting its independence, and the works of industry were resumed, we find a great advance was made in iron-making. In 1810, the whole number of furnaces in the United States was 153, giving a production of 54,000 tons per annum ;—equal to about 16 lbs. per head of the population. From 1810 to 1820, but little progress was made, the trade being in a very depressed state. In 1828, the production had reached 130,000 tons, having been rather more than doubled in the 18 years. In 1829, it is given at 142,000 tons, showing an increase in one year of nearly 10 per cent.

In 1830, it was 165,000 tons, exhibiting an increase of 16 per cent. In 1831, the production was 191,000 tons; and in 1832 it reached 200,000 tons, thus showing an increase of 70,000 tons, or 55 per cent., in the four years since 1828. In 1840, the census returns give the gross production at 286,903 tons: however, according to the Report of the Committee of the Home League in New York, it was estimated at 347,700 tons. The mean of the two would probably give the safest estimate; this would be 315,000 tons, or an increase equal to upwards of 50 per cent. in the eight years. In 1842, many of the works were closed, and the production fell to about 225,000 tons. In 1846, the trade was in a prosperous state again, the gross production for that year being estimated by the Secretary of the Treasury at 768,000 tons,—having thus been trebled in four years; and in the following year it is supposed to have reached its maximum amount, not less than 800,000 tons being the furnace returns for that year. Circumstances, commercial as well as fiscal, appear then to have exerted a depressing influence upon the trade, and to have checked its career, as in 1848 a downward tendency is shown, which caused a decrease of about 150,000 tons in the following year's make, and another reduction of 100,000 tons at least in that of 1850. The production for that year, according to the census returns, is given at 540,000 tons : this is, probably, too high an estimate, as we find from the Report of the Statistical Committee of the Ironmasters' Convention, that the entire make in the State of Pennsylvania for that year was 198,813 tons ; whereas the census returns give it at 285,703 tons, a difference in excess of 86,890 tons in one State only. In the following year, trade again reviving, a regular increased production has taken place, and the returns for the past year (1853-4) present the satisfactory appearance of a make equalling the maximum which the trade had reached previous to the depression.

The iron-making resources of the United States are very great: the distribution of ores, many of the richest description, is general throughout the Atlantic and Western States; while the enormous area occupied by the coal-measures testifies to the abundance of fuel for the development of industrial applications.* The ores comprise every variety found in Europe : those principally used for smelting are the magnetic oxides, the hæmatites, and the clay carbonates of the coal-veins. Besides these, the "spathic or sparry carbonate" and the "oligist or specular ore" are used in some of the New England States, but only to a limited extent. Quite recently, a discovery has been made of rich seams of black band, in connexion with the bituminous deposits of the great Eastern Coal-field, which will probably hasten the development of this industry in that favoured region. The magnetic oxides and the hæmatites are dispersed pretty generally throughout the whole extent of the Union, from Maine to Texas, and from the Atlantic seaboard to the States of the far West. The clay carbonates are associated with the coal-measures lying west of the Alleghanies. In general, they are not so rich as those in this country ; but when mixed with the hydrated hæmatites which are met with skirting the coal districts, these ores are profitably worked up. They are also found in considerable deposits on the Atlantic side of the mountain chain in Pennsylvania, Maryland, Virginia, and North Carolina. The spathic ores are found chiefly in Connecticut and Vermont, and where they are worked in the old way, with charcoal and the cold blast, furnish iron of first-rate quality. The specular iron ores occur in the New England States, and in New York State to a comparatively limited extent :—in the more distant States, both of the south and west—Texas, Arkansas, Missouri, Iowa and California, they are reported to exist in great abundance. The industry was first established in the New England States, where the ores and the fuel (wood) were in great abundance, and where the education, habits, and energies of the people were well adapted to the prosecution of new industrial pursuits. The existence of coal in the State of Pennsylvania soon, however, raised a formidable rival; and from the year 1820, when mineral fuel was first worked and sent to market, the production of iron in that State increased so rapidly as to cause it to become the great centre of the industry, and to give it the entire control of the home market. This position it still holds, and must do so for some years to come, until the still greater resources of the States west of the Alleghanies are sufficiently developed to contest the lead with their more advanced neighbour. These possess natural advantages superior for iron-making purposes to those of Pennsylvania. Associated with the coal-measures, beds of iron ores, and also of limestone, are met with generally throughout their vast area; whereas, in Pennsylvania, the ores and the fuel have to be sought for in different localities. Thus, while the smelting furnace within the one district finds a ready supply of both ores and fuel immediately at hand, the location of the other has to be determined by calculations based upon the comparative cost of transport to the furnace of the necessary ingredients—the fuel and the ores. In my recent inquiry into the iron industry of the Union, I was led to a divisional arrangement, as best adapted for showing the chief seats of the industry, with their respective advantages and capabilities. These I will briefly give now, with their production in the last year (1853-4), and the estimated cost of manufacture :—

1. The Housatonic district—Production, 10,000 tons ; cost per ton, 20 dols. to 25 dols.
2. The Hudson River district—Production, 80,000 tons ; cost per ton, 18 dols. to 20 dols.
3. The Delaware and Lehigh Rivers district—Production, 120,000 tons ; cost per ton, 16 dols to 18 dols.
4. The Schuylkill River district—Production, 100,000 tons ; cost per ton, 20 dols.
5. The Susquehannah River district—Production, 120,000 tons ; cost per ton, 15 dols. to 18 dols.
6. The Potomac River district—Production, 125,000 tons ; cost per ton, 20 dols.
7. The Ohio, Cumberland, and Tennessee Rivers district—Production, 150,000 tons ; cost per ton, 20 dols.

Besides these well-defined districts, we must allow about 100,000 tons as the production of the numerous isolated works scattered throughout the upper portions, especially of the Atlantic States, where charcoal as fuel is universally used. In these iron of the best quality is made, but at a cost of nearly double that of the coal furnaces.

The present consumption of iron in the United States may be taken at 1,200,000 tons, which approximates very closely to the estimate mentioned by Mr. Scrivenor, as given by Mr. Wœrn, of Sweden, viz., 88 lbs. per head of the population. To meet this the home production is not at present equal; about half the present make is consumed for castings, and the remaining portion is converted into wrought-iron, at a loss in waste, &c., of about one-third. This practically reduces the total or available production to 700,000, leaving a deficiency of 500,000 tons to be supplied by other countries. Hitherto the demand has increased in a ratio far beyond the ratio of production; but as the capability of production is in this case entirely a commercial question, the interests of the supplying countries are affected equally with

* Substance of a Paper read before the Royal Society of Arts, Feb. 28, 1855.

* Professor Wilson here pointed out on a large map, which had been kindly lent for the purpose by Mr. Stanford, of Charing-cross, the districts occupied by the coal-measures, and explained generally the characteristics of each.

those of the consuming country, by all circumstances, whether fiscal or industrial, which are brought to bear upon it.

	1840. Tons.	1850. Tons.	1852. Tons.
Make of iron	286,903	564,755	500,000
Quantity imported	80,886	441,514	501,158

This large importation to meet the home consumption is obtained entirely from this country, and forms a very important item in the commercial intercourse of the two countries. The value of the United States' market to our iron manufacture may be readily seen in the Board of Trade returns, which give the exports for the years 1851 and 1852 respectively :—

	1851. Tons.	1852. Tons.
To the United States	464,559	501,158
To other countries	295,211	393,266

Thus giving an excess of about one-third in favour of the United States over the gross exports to other countries.

To retain this good customer, of course, is very desirable ; and, from what I was enabled to glean of their resources, and what I know of our own, I am strongly of opinion that this may be done for many years to come ; but the time and the quantity will depend materially upon our "economy of production." At the present time, when the consumption doubles the home manufacture, the markets of the Atlantic States are virtually ruled by the prices of iron in this, the supplying country. As long as the price of English iron prevents its importation into the Union under 20 dols. for pigs, and English bar-iron under 50 dols. per ton, the home manufacture can compete profitably with it in their markets, and the iron industry of the States will flourish and increase. Any fall in the English iron that would bring down its price in the American markets lower than the sum quoted would immediately check their home production, and again throw them upon our markets for their supplies. The difference in price between the two markets may be taken at 80 per cent. This includes all charges for freight, commission, insurance, &c., about 50 per cent., and the *ad valorem* import duty of 30 per cent. In round numbers, pig-iron selling at Liverpool at 45s. to 50s. will cost 20s. at New York. Thus the ironmasters of the States possess a *natural protection* of 50 per cent., which will always remain, and an *artificial* one of 30 per cent., which, like all fiscal charges, is liable to be changed.

The fiscal charges have undergone several changes, each gradually reducing the State protection, and leading the industry to the more healthy condition of reliance upon its own vast resources. In 1815 the duty on imported pigs was fixed at 1.50 dols. per cwt. In 1818 it was reduced to 50c. per cwt. In 1828 it was slightly raised, being 62½c. per cwt. In 1830 it was again fixed at 50c. per cwt., and in 1842 it was reduced to 9 dols. per ton. In 1846 the present *ad valorem* duty of 30 per cent. was established. These several changes have had their effect upon the development of the home manufacture; but the great variations seen in the annual production may be traced to other causes, of which the rise and fall in our markets appear to be the most important.

The iron industry of the United States is at present only in its infancy, an offspring quite of the present century. Its growth has been somewhat irregular, it is true; but when we find that it has already reached the gross amount made in this country only twenty years ago, and when we recollect the vast mineral resources of the United States, the rapid increase of population, with its increasing demands, and its unquestionable energies and power of application, it forces upon our minds the conviction that the time is not far distant when it will not only furnish sufficient for its own consumption, but be in a position to compete with us in the other importing markets of the world. In the different districts I visited, I found every advantage taken of our experience in the construction and working of their establishments. Everywhere the charcoal forge was giving way to the superior advantages of the hot-blast anthracite furnace. *Economy of production* was the main object of the manufacture, the quality of their ores and fuel always guaranteeing a good article. The use of the waste gases of the furnace was universal in their establishments ; the difference of opinion as to their value, so startling in this country, did not appear to exist there. Attempts were being made also to utilise another waste, and, at the same time, cumbersome product—the slag or cinder. This, by a process of annealing, is susceptible of conversion into a hard and durable material, which, moulded into shapes, is adapted for various purposes of construction, or, with the additional labour bestowed upon it in polishing, is suitable for ornamental applications. Some specimens which I had an opportunity of seeing in the States were apparently homogeneous in their composition, and perfectly vitrified. Those now on the table were obtained by the same process, from the Dowlais furnaces. If this process can be brought into successful operation on a large scale, it will be the means of affording us a very useful and desirable material at a low cost, while at the same time it will help to consume a waste product, which at present is an expense to the ironmaster to remove. Another process, too, which I saw in operation in the States, appears to me worthy of consideration here—that of making wrought-iron *direct* from the ore. This has long been a desideratum in all iron-producing countries : many attempts have been made, but none, I believe, have been so successful as to induce an operation on a large scale.

The process I refer to was patented by Renton, in 1851, and was in operation at Cincinnati, and at Newark, New Jersey. The description and particulars of working I have given at length in my report to H.M. Government. Another operation of some magnitude for a similar purpose, and based on a similar principle (Harvey's patent), is carried on at Motthaven, New York, where the returns, I am informed, are equally satisfactory. In both the conversion is effected by mixing the ores with a proportion of fuel, both being reduced to a coarse powder, and raising the temperature by means of heat applied externally to the chamber in which the mixture is contained. The fuel is ignited, and burns at the expense of the oxygen of the ore, and metallic iron is left mixed with the foreign substances usually accompanying such minerals. This reduced ore descends through a shoot to a furnace, suitably arranged, and subjected to a temperature sufficient to bring the iron to a pasty condition, when it is worked together as in a puddling-furnace, and drawn out in balls of the required size for tilting. By this process a great saving is effected, as the entire expenditure of exertion, fuel, and labour would not much exceed that of the ordinary process of puddling—while at the same time a superior quality may be expected, as the temperature at which the deoxidising action is carried on is not high enough to cause the iron to combine either with the carbon of the fuel, or with any of the other impurities, as silicon, sulphur, phosphorus, &c., which are always found in the ordinary pig-iron. The first (Renton's), I am informed, will shortly be in operation at the Llynvi Valley Works, South Wales. The sectional diagrams of the furnaces used show their management, and on the table are specimens of the manufacture of both the processes, and also of the principal ores used in the manufacture of iron in the States. The great abundance of the magnetic oxide, the richest of all iron ores, and its proximity in many localities to the coast, I am inclined to think, place it quite within the reach of our ironmasters who may require additional material, either for increasing the quantity or for improving the quality of their produce. In conclusion, I would venture to specify, as my claims to the attention of the meeting, the consideration of the following points :—

1. The make and the consumption of iron in the United States.
2. The deficiency supplied from Great Britain, and the relative value of the United States' trade to this country.
3. The relative price in the two markets—the natural and artificial protection of the United States.
4. The enormous mineral resources of the United States.
5. The desire for economising the cost of manufacture.

COUPLING AND UNCOUPLING RAILWAY CARRIAGES, &c.

Messrs. Joseph Taylor and Charles D. Cranstoun, of Morayshire, have patented an invention relating to the arranging and connecting details of carriages and waggons. By this invention, it is said, the attendants may effect the necessary actions of coupling and uncoupling in a complete manner without involving the necessity of passing in between the carriages and waggons, whilst these operations may also be accomplished with much greater facility and speed than by the existing systems. Each carriage or waggon, in addition to draw-hooks, has attached to it three parallel-jointed engaging chain-links, freely hinged, so as to be capable of being raised or lowered at pleasure. These links are made with a central hook stop-joint, in such manner, that whilst they will act with all necessary flexibility when drawing or being shifted in certain directions, yet, when lifted by the elevating lever, they will rise in a rigid condition as if solid. Such draw-links may either be disposed in sets of three at each end of the carriage or waggon, or they may be at one end only, with corresponding draw-hooks at the opposite end of the carriage or waggon framing. A transverse coupling or elevating shaft is disposed in bearings beneath each set of links; this shaft having upon it a lever frame-piece, with stud projections thereon, for the purpose of giving the lift to the links. Each end of the shaft carries a hand-lever, conveniently disposed for the hand of the attendant, so that when passing along either side of the train he can quickly lift or lower the links, holding-pins being provided for setting the levers at the required point.

When the waggons are to be coupled, they are placed together in the usual manner; the attendant then passes along either side of the train and removes the holding-pin (which supports the links sufficiently high to clear the three corresponding hooks on the next waggon); the links then drop, and the necessary engagement is thus instantly effected. When the waggons are to be uncoupled, the attendant lifts the links clear off the hooks by simply pressing down the hand-lever, and either allows the links to drop to a vertical position when the waggon is removed, or, by inserting the holding-pin, the links are fixed in a position for coupling when the waggons are brought together, which can instantly be effected by the removal of the holding-pin as already described. The action of the coupling thus places the links in position for coupling whenever the waggons are brought together.

The carriages are coupled or uncoupled in the same manner as the waggons, with the exception that the centre or draw-link requires to be tightened up after the carriages are coupled to bring them closely together, and slackened off sufficiently when they are to be uncoupled. To effect this, a transverse hand-wheel shaft is fitted upon the carriage-frame; the centre of this shaft having upon it a worm gearing with a worm-wheel set on a longitudinal nut-link of the draw-hook spindle. Hence, by turning one or other of the hand-wheels, the draw-link is tightened or slackened as required. This gearing may be modified in various ways: for instance, the worm-wheel may itself be made to answer as the tightening-nut.

Although the invention had been thoroughly approved by several of the first railway men of Scotland, the inventors considered it most prudent to keep it as secret as possible until the plan should be practically tested: consequently, all doubts as to its working are considered as now entirely removed. It has been tried on the Morayshire line with perfect success, and is there described as both complete and instantaneous in its action.

The adoption of this invention, we are told, will cost very little, as it can be made to work with the greater portion of the fittings of existing couplings. Irrespective of the leading principle of the invention—namely, a perfect prevention of all those accidents which are and have been so numerous and fatal, arising from the existing imperfect system of coupling carriages and waggons—the saving of time which it effects ought to more than counterbalance the expense of its adoption. It has, however, another important advantage which should be noticed. It frequently happens, from the defective couplings at present in use, that a train becomes disconnected on the journey; and from the peculiarly flexible construction of this coupling, no such accidents could possibly occur where it was in use.—*Railway Times.*

NOTES AND NOVELTIES.

New Railway Station at Boulogne.—A correspondent writes—"The new station at Boulogne, opened for traffic last autumn, but not yet completed, is a great improvement. The new building is externally of the form and appearance of a Gothic church, constructed of red and white bricks, and consists of a long nave parallel to the harbour, crossed by a transept rising to a considerable height. Over the centre of the transept, facing the harbour, is a handsome clock-tower. This part of the transept is arranged for the reception of travellers about to depart, while passengers arriving at Boulogne quit the station from the other extremity of the transept, looking away from the harbour. Under the nave are the arrival and departure platforms, both extremely wide, between which are three lines of rails. The roof rises to a great height, and being partially covered with glass, gives much lightness to the interior effect of the structure. The various offices, ticket and luggage counters, refreshment rooms, &c., will be very convenient when completed, and occupy the transept, and what may be called aisles running along the sides of the nave. The building is evidently one of the new description of constructions suggested by the iron and glass buildings of Sir Joseph Paxton, and is a very creditable specimen of a first-class provincial station. The total cost was about £20,000; and the situation is very convenient, just opposite the new bridge, which is open for traffic, and makes this station not half so far from the steam-boat wharf as the former station was by way of the old bridge. The station is commodious, and satisfies a want greatly felt by the increasing traffic at Boulogne, both by its extra convenience for passengers, and from its having left the provisional station to be added to the insufficient accommodation previously provided for the goods traffic."—*Railway Times.*

Improvement in Screw Steam Machinery.—A very simple but effectual plan has recently been introduced by Mr. Penn, the eminent engine-maker, for preventing that constant and excessive wear and tear of the bearings on the shafts of screw-steamers which has hitherto been found so great a practical difficulty and so continually recurring a source of expense. He introduces between the bearing and the shaft thin slips of wood, which have the remarkable property of entirely suspending that incessant waste of material which, after a certain pressure on the square inch has been attained, is constantly in progress. This simple expedient has been adopted in the recent repairs of the *Himalaya*, and will probably be applied, if found successful in her case, to all screw-steamers. While the surface of the bearing is preserved from waste, singularly enough the slips of wood show no indication of being rubbed away or heated.—*Nautical Standard.*

— The Mersey Steel and Iron Company (the Old Potteries, Liverpool) have been lately employed in executing Government work, and just completed a contract for 160 tons of iron plates, to be used in the construction of the gun-boats for the Baltic. These plates are 12 feet long, 4½ inches thick, and 2 feet 10½ inches wide. Each plate weighs 2 tons 13 cwt., and they are all finished and planed on the edges. The plates were made at the rate of 40 tons a week. At the same works an immense crank for the engines of her Majesty's screw line-of-battle ship *Marlborough*, 131 guns, the largest vessel yet built, is being forged. It is the largest double-throw (or locomotive) crank ever forged, and, when complete, it will weigh about 17 tons of wrought iron. The 9-ton steam-hammer is the principal instrument made use of in the forging process.

DIMENSIONS OF STEAMERS.

LIVERPOOL AND MEDITERRANEAN NEW IRON SCREW-PROPELLER STEAM-VESSEL "CINTRA."

Built and fitted by Messrs. Blackwood and Gordon, engineers and iron shipbuilders, Paisley, 1854.

Dimensions.		ft.	tenths.
Length on deck		176	4
Breadth at two-fifths of midship depth		23	1
Depth of hold at midships ...		14	9
Length of half-poop		55	2
Breadth of ditto		19	4
Depth of ditto		3	4
Length of engine-room		42	2
Ditto of shaft-tunnel		50	4
Breadth of ditto		3	9
Depth of ditto		4	7
Tonnage.		Tons.	
Hull		$477\frac{28}{100}$	
Half-poop		$39\frac{40}{100}$	
Total		$516\frac{68}{100}$	
Engine-room ...	$157\frac{19}{100}$	$167\frac{18}{100}$	
Shaft-tunnel ...	$9\frac{99}{100}$		
Register		$349\frac{50}{100}$	

Fitted with a pair of steeple engines (on Mr. David Napier's 4-piston-rod patent principle), of 90-horse nominal power: diameter of cylinders, 38 inches, and 2 feet 6 inches length of stroke. Screw-propeller: diameter, 10 feet; pitch expanding from 9 feet to 10 feet 6 inches; has three blades. One tubular boiler: length, 11 feet 10 inches; breadth, 13 feet 1 inch; depth, 11 feet 10 inches. Three furnaces. 262 tubes: diameter, 3¼ inches, and 7 feet long. Carries 150 tons of coals in bunkers. Frames, 4 × 3 × $\frac{7}{16}$ and ⅜ inches; double amidships, and 18 inches apart. Thirteen strakes of plates from keel to gunwale, tapering in thickness from $\frac{9}{16}$ to $\frac{7}{16}$ of an inch in thickness. Iron bulwarks. Accommodation for 20 first-class passengers below. Half-poop is provided with patent steering-gear. Carries 500 tons of cargo; classed A 1 at Lloyd's. This vessel has made the quickest run from Oporto to Liverpool on record. Was launched from Cartvale building-yard, on the 23rd of October, and the largest vessel built at Paisley. The back and front of propeller-blades are exactly the same, with good results.

DESCRIPTION.

A trident boy figure-head; elliptical-sterned and clinch-built vessel; stationary bowsprit; two masts; brig-rigged; no galleries.

Port of Liverpool. Owners, Messrs. John Bibby, Sons, and Co.

THE KIAMA STEAM NAVIGATION COMPANY'S NEW IRON PADDLE-WHEEL STEAM-VESSEL "KIAMA."

Built and fitted by Messrs. Lawrie and Co., engineers and iron shipbuilders, White Inch, Glasgow, 1854.

Dimensions.	ft.	tenths.
Length on deck	123	4
Breadth at two-fifths of midship depth	19	4
Depth of hold amidships	8	0
Length of quarter-deck	40	5
Breadth of ditto	17	2
Depth of ditto	1	6½
Length of engine-space	23	9
Tonnage.	Tons.	
Hull	$135\frac{06}{100}$	
Quarter-deck	$12\frac{48}{100}$	
Total	$147\frac{54}{100}$	
Contents of engine-space	$40\frac{10}{100}$	
Register	$107\frac{44}{100}$	

Fitted with a pair of oscillating engines of 60-horse nominal power: diameter of cylinders, 30 inches; length of stroke, 3 feet; with two inclined air-pumps. Diameter of paddle-wheels over paddle-boards, 14 feet. Fourteen paddle-boards: length, 5 feet 6 inches; breadth, 15 inches. Two tubular boilers: length at crown, 10 feet 1 inch; ditto at furnaces, 8 feet 10 inches; breadth, 7 feet 6 inches; depth, 7 feet. 170 cubic feet in steam-chests. Six furnaces, three in each boiler: length of fire-bars, 6 feet 6 inches; breadth, 1 foot 8½ inches. 168 tubes, or 84 in each boiler: diameter, 2⅝ inches; length, 7 feet. Chimney: diameter 3 feet, and 24 feet long. Carries 10 tons of coals in bunkers. Frames, 3 × 3 × ⅜ inches, and 18 inches apart. Eight strakes of plates from gunwale to keel, tapering in thickness from ½ to ¼ of an inch thick. Four bulkheads. Launched August 21st, with all the machinery on board. Trial-trip in September: the speed per hour, 10 miles; steam-pressure, 15 lbs.: draft of water at trial, forward, 4 feet 9 inches; aft, 6 feet 6 inches. Will carry 150 tons of cargo. For the Australian coasting trade; classed A 1. Sailed from Glasgow for Sydney, N. S. W., on the 21st of October; and neatly fitted up for passengers, &c.

DESCRIPTION.

A full female figure-head; clipper-bow; elliptical-sterned and clinch-built vessel; standing bowsprit; three masts; schooner-rigged.

Port of Sydney. Commander, Mr. Samuel Charles.

AUSTRALIAN COASTING NEW IRON SCREW-PROPELLER STEAM-VESSEL "STORM-BIRD."

Built and fitted by Messrs. Lawrie and Co., engineers and iron shipbuilders, White Inch, Glasgow, 1854.

Builders' measurement.	ft.	in.
Length from figure-head to taffrail	117	0
Ditto of keel and fore-rake ...	108	9
Breadth of beam	19	1½
Depth of hold amidships	8	2
Length of engine-space	21	0

		ft.	in.
Ditto of shaft-tunnel	... ...	22	2
Breadth of ditto	... ...	2	0
Depth of ditto	... ...	3	1
Tonnage.		Tons.	
Hull ...	... ...	$189\frac{86}{94}$	
Engine-space ...	$39\frac{59}{94}$ }	$39\frac{99}{94}$	
Shaft-tunnel ...	$0\frac{40}{94}$ }		
Register	... ...	$149\frac{92}{94}$	
Customs' measurement.		ft.	tenths.
Length on deck	... ...	107	$8\frac{1}{2}$
Breadth at two-fifths of midship depth		18	$4\frac{1}{2}$
Depth of hold amidships ...	...	8	2
Length of quarter-deck	... ...	25	$2\frac{1}{2}$
Breadth of ditto	... ...	15	1
Depth of ditto	... ...	1	$8\frac{1}{2}$
Length of engine-space	... ...	21	0
Ditto of shaft-tunnel	... ...	22	2
Breadth of ditto	... ...	2	0
Depth of ditto	... ...	3	1
Tonnage.		Tons.	
Hull ...	... ...	$104\frac{69}{100}$	
Quarter-deck	... ...	$6\frac{68}{100}$	
Total...	... ...	$111\frac{37}{100}$	
Engine-space ...	$30\frac{70}{100}$ }	$32\frac{10}{100}$	
Shaft-tunnel	$1\frac{40}{100}$ }		
Register	... ...	$79\frac{27}{100}$	

Fitted with a pair of inverted cylinder engines of 20-horse nominal power: diameter of cylinders, 20 inches; length of stroke, 2 feet: diameter of air-pumps, 12 inches. Screw-propeller: diameter, 6 feet; pitch, 14 feet; length on axis, 1 foot 9 inches: has three blades. One tubular boiler: length at crown, 8 feet 4 inches; ditto at furnaces, 7 feet 1 inch; breadth, 7 feet; depth, 10 feet. No steam-chest. Two furnaces: length, 5 feet 7 inches; breadth, 2 feet 6 inches. 108 tubes (brass): diameter, $2\frac{3}{4}$ inches; length, 5 feet 1 inch. Chimney: diameter 2 feet, and 30 feet long. Intended to carry 100 to 200 tons weight of cargo, on 8 feet draft of water. Trial-trip in June: draft of water forward, 3 feet 6 inches, and 6 feet aft; 70 revolutions per minute: speed with tide, 12 miles per hour; ditto against ditto, 9 miles. Frames, $3 \times 3 \times \frac{3}{8}$ inches; and 18 inches apart. Eight strakes of plates from keel to gunwale, tapering in thickness from $\frac{1}{2}$ to $\frac{1}{4}$ of an inch in thickness. Four bulkheads. Classed A 1 at Lloyd's.

DESCRIPTION.

A full bird figure-head; clipper-bow; standing bowsprit; two masts; schooner-rigged, round-sterned, and clinch-built vessel. Port of Glasgow.

THE NEW IRON SCREW-PROPELLER STEAM TRANSPORT-VESSEL "SOVEREIGN."

Built and fitted by Messrs. Lawrie and Co., iron ship-builders and engineers, White Inch, Glasgow, 1854.

Dimensions.		ft.	tenths.
Length on deck	... ...	196	8
Breadth at two-fifths of midship depth	... ...	24	9
Depth of hold amidships ...	...	18	1
Length of engine-room	...	45	3
Ditto of shaft-space	... ...	67	0
Breadth of ditto	... ...	1	8
Depth of ditto	... ...	1	9
Tonnage.		Tons.	
Hull ...	... ...	$602\frac{24}{100}$	
Engine-room ...	$220\frac{95}{100}$ }	$222\frac{99}{100}$	
Shaft-space ...	$2\frac{04}{100}$ }		
Register	... ...	$379\frac{25}{100}$	

Fitted with a pair of geared angular engines, of 100-horse nominal power: diameter of cylinders, 40 inches; length of stroke, 3 feet; having reversing gear. Screw-propeller: diameter, 11 feet 6 inches; pitch, 11 feet 6 inches; two blades. One tubular boiler, fired fore and aft: length at roof, 17 feet 6 inches; ditto at furnaces, 16 feet; breadth, 10 feet 3 inches; depth, 9 feet 6 inches. Steam-chest: length, 12 feet 6 inches; breadth, 5 feet; depth, 5 feet 3 inches. Six furnaces, three at each end of boiler: length, 6 feet 6 inches; breadth, 2 feet 8 inches; depth, 2 feet 11 inches. 230 cubic feet in steam-chest. 456 brass tubes, or 228 at each end of boiler; diameter, $2\frac{7}{8}$ inches, and 6 feet long. Chimney: diameter, 3 feet 6 inches, and 24 feet long. Contents of coal-bunkers, 120 tons. Weight of engines, 70 tons; ditto of boiler and water, 30 tons; ditto of iron hull, 200 tons; ditto of wood, &c., 150 tons. Launching draught of water forward, 7 feet; ditto aft, 9 feet 10 inches; displacement, 450 tons. Stem, 6×2 inches; stern-post, 6×4 inches; frames, $4 \times 3 \times \frac{7}{16}$ inches, and 18 inches apart. Twelve strakes of plates from keel to gunwale, tapering in thickness from $\frac{5}{8}$ to $\frac{3}{8}$ of an inch. Launched on 14th January, with all the machinery on board. Trial-trip, February 5th, engines making 38 revolutions per minute; steam pressure, 15 lbs. The speed of the vessel was 14 miles with tide, and $10\frac{1}{2}$ against ditto; draft of water forward, 9 feet 6 inches, and 11 feet 6 inches aft. Consumes 15 cwt. of coals per hour; has six bulkheads. Employed in the Black Sea, &c.; $604\frac{23}{94}$ tons O.M.

DESCRIPTION.

A demi-woman figure-head; square-sterned and clinch-built vessel; clipper-bow; standing bowsprit; two masts; brig-rigged; two decks, flush.

Port of London.

CLYDE, NEWFOUNDLAND, ETC. LINE OF PACKETS —"ICENI."

Built by Messrs. Robert Steele and Co., shipbuilders, Greenock, 1853.

Dimensions—Builders' measurement.		ft.	in.
Length of keel and fore-rake	...	109	4
Breadth of beam	... ...	23	0
		Tons.	
Register	... ...	$268\frac{76}{94}$	
Customs' measurement.		ft.	tenths.
Length on deck	... ...	108	6
Breadth at two-fifths of midship depth	... ...	21	0
Depth of hold amidships ...	...	14	8
Length of quarter-deck	... ...	23	4
Breadth of ditto	... ...	17	3
Depth of ditto	... ...	2	1
Tonnage.		Tons.	
Hull ...	... ...	$257\frac{57}{100}$	
Quarter-deck	... ...	$9\frac{20}{100}$	
Register	... ...	$266\frac{77}{100}$	

Classed 13 years A 1 at Lloyd's; carries 395 tons of cargo. Launched July 5th.

DESCRIPTION.

A female bust figure-head; square-sterned and carvil-built vessel of timber; no galleries; standing bowsprit; two masts; brig-rigged. Port of Greenock. Owners, Messrs. Kerrs and Macbride.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 10th January, 1855.

67. H. Bessemer, Queen-street-place, New Cannon-street—Ordnance.

Dated 13th January, 1855.

92. J. Britten, Birmingham—Filtering liquids.

Dated 20th January, 1855.

161. J. H. Johnson, 47, Lincoln's-inn-fields—Seats. (A communication.)

Dated 24th January, 1855.

182. J. Livesey, New Lluton—Lace machinery.

Dated 26th January, 1855.

197. W. Binns, Claremont-villa, Brompton, and J. Haughton, Oldham—Valves.

Dated 27th January, 1855.

207. J. Hutchinson, Huddersfield—Apparatus to economise steam.
210. E. Davis, Aldgate—Waterproofing paper.

Dated 30th January, 1855.

231. H. D. Pochin, Salford—Compounds of alumina and their application.

Dated 3rd February, 1855.

253. F. S. Thomas, 17, Cornhill, and W. E. Tilley, 6, Kirby-street—Coating metals.
254. P. M. Crane, Attry, Kildare—Products from peat.
255. J. T. Chance, Birmingham—Glass pipes.
257. J. Patterson, Beverley — Washing, wringing, and mangling machinery.
259. J. Lippman, Paris—Dyeing skins.
261. T. Allan, Adelphi-terrace—Motive power.

Dated 5th February, 1855.

263. G. Pattison, Glasgow—Finishing woven fabrics. (A communication.)
265. J. H. Johnson, 47, Lincoln's-inn-fields—Steam-boilers. (A communication.)

LIST OF PATENTS.

267. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Preserving railway tickets. (A communication.)
269. E. Hartnall, 1, St. Mary Axe—Preserving food.
271. J. Gibbons, 345, Oxford-street—Fixing spindles of door-locks to knobs.
273. T. B. Daft, Isle of Man—Beds.

Dated 6th February, 1855.

275. J. Gedge, 4, Wellington-street South, Strand—Frames for photographic portraits. (A communication.)
277. T. Aston, Compton-street, Regent's-square—Communicating with drivers of carriages.
279. A. Warner, 11, New Bond-street—Coating sheet-iron and steel with lead, &c.
281. P. Smith, Glasgow—Printing textile fabrics.
283. G. Audemars, Lausanne—Treating vegetable fibres.

Dated 7th February, 1855.

285. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Motive power by heated air. (A communication.)
286. W. Warbrick, Dukinfield, and J. Walker, Compstall-bridge, Stockport—Spinning machinery.
287. J. G. Johnson, 18A, Basinghall-street—Surgical bandages.
288. G. T. Bousfield, Sussex-place, Loughborough-road—Steam ploughing-machines. (A communication.)
289. E. Davies, Liverpool—New oil.
290. G. T. Bousfield, Sussex-place, Loughborough-road—Looms. (A communication.)
291. R. D. Chatterton, Cobourg, Canada West—Propelling vessels.
292. A. J. Hoffstaedt, Albion-place, Blackfriars, and S. Blackwell—Powder-flasks and shot-belts.
293. G. Briggs, Wigmore-street—Carriage-spring.
294. A. V. Newton, 66, Chancery-lane—Spur. (A communication.)
295. A. V. Newton, 66, Chancery-lane—Dry docks. (A communication.)
296. W. Hartfield, Prospect-place, Bermondsey—Hook-covers in tortoiseshell, and also inlaid with pearl and ivory, &c.

Dated 8th February, 1855.

297. J. Wilson, Manchester—Rollers for printing fabrics.
298. A. Girard, Pertuis, Vaucluse—Extinguishing fires.
299. F. Puls, Soho-square—Apparatus for smoking tobacco.
300. J. Armstrong, Normanton—Permanent way.
301. G. F. Wilson and G. Payne, Vauxhall—Glycerine.
302. F. Ransome, Ipswich—Drying articles made of plastic materials.
303. R. J. Mary'on, 37, York-road, Lambeth—Ordnance and fire-arms.

Dated 9th February, 1855.

304. C. Armsdell, Fenchurch-street—Sifter.
305. J. Martin, Liverpool—Treating grain.
306. W. H. Adams, 1, Adam-street, Adelphi—Elastic springs.
307. J. Lees and W. Heap, Ashton-under-Lyne—Machine for cutting bars of metal.
308. W. B. Johnson, Manchester—Steam boilers and engines.
309. B. Pont, Paris—Autographic engraving.
310. F. Parker, Northampton—Paper.
311. J. Langman, Plymouth—Portable buildings.

Dated 10th February, 1855.

312. C. Barnard and J. Bishop, Norwich—Apparatus for cutting vegetable substances.
313. E. Sparkfield, 142, Cheapside—Exhibition of pictorial representations.
314. C. H. Ingall, Throgmorton-street—Telegraph apparatus.
315. S. Russell, Sheffield—Projectiles.
316. G. H. and H. R. Cottam, Old St. Pancras-road—Iron buildings.
317. W. Balk, Ipswich—Machinery for crushing grain.
318. A. Sands, Liverpool—Substitute for clothes-pegs. (A communication.)
319. L. A. F. Hesnard, Paris—Fixing lithographs, &c. on canvas.
320. A. E. L. Bellford, 32, Essex-street, Strand—Materials for cementing painting, &c. (A communication.)
321. G. Rennie, Holland-street—Marine engines.

Dated 12th February, 1855.
322. J. Ramsbottom, Longsight, near Manchester—Metallic pistons.
323. S. Smith, Manchester—Winding yarns.
324. G. Lucas, Hulme, Manchester—Spinning machinery.
325. D. Barr, Birmingham—Tap.
326. R. Kerr, 41, Coleman-street—Loaf-sugar.
327. R. S. Harris, Leicester—Looped fabrics.
328. J. Foster, Long Eaton—Lace machinery.

Dated 13th February, 1855.
329. S. Smith and M. Morris, Manchester — Spinning machinery.
330. J. L. Lambot, Carces, Var—Building material as a substitute for wood.
331. A. Vallery, Rouen—Machinery for preparation of flax, hemp, &c.
332. R. P. Courfield, Upper Holloway—Electro-coating of iron, &c. (Partly a communication.)
333. G. Dalton, Lymington—Reverberatory furnaces.

Dated 14th February, 1855.
334. T. Metcalfe, W. Slaiding, and J. Metcalfe, Clitheroe—Dyer's tube-frames.
335. J. H. Johnson, 47, Lincoln's-inn-fields — Governors. (A communication.)
336. I. R. Isaac, Liverpool—Portable buildings.
337. J. Nichol, Edinburgh—Bookbinding.
338. H. L. Pattinson, jun., Newcastle-upon-Tyne — Iron carriage-wheels.
339. F. B. Blanchard, Maine, U.S. — Apparatus for generating motive power.

Dated 15th February, 1855.
340. W. Blythe, Oswaldtwistle, and E. Kopp, Accrington—Soda-ash and sulphuric acid.
341. R. Molesworth, Halfmoon-street, Bishopsgate-street—Brushes.
342. J. Leadbetter, Halifax—Railway-brakes.
344. J. Mason and S. Thornton, Rochdale, and T. S. Sawyer, Longsight—Finishing yarns.
345. H. Spencer, Rochdale—Spinning machinery.
346. C. F. Delabarre, Paris—Apparatus for propelling gases and forcing liquids.

Dated 16th February, 1855.
347. W. Spence, 50, Chancery-lane—Substitutes for glass for ornamental purposes. (A communication.)
348. E. Carless, Stepney—Paper cloth, or artificial leather.
349. W. Abbott, Richmond—Boot and shoe cleaning machine.
350. W. C. S. Percy and W. Craven, Manchester — Bricks, tiles, pipes, &c.
352. H. L. Pattinson, jun., Newcastle-upon-Tyne — Wrought-iron tubes.
353. F. G. P. M. V. Maneglia, Turin and Genoa—Railway carriages.
354. R. Blackburn and W. L. Duncan, Wandsworth — Bleaching.
355. S. B. Wright, Parkfields, Stone, and H. T. Green, Moreton—Encaustic tiles.
356. A. H. Ward, jun., Massachusetts—Loom-temple. (A communication.)

Dated 17th February, 1855.
357. J. Wright, 16, Park-street, Kennington — Consumption of smoke.
359. J. Hackett, Derby—New fabric for umbrellas, &c.
360. J. Hackett, Derby—Leather cloth.
361. J. Oxley, Beverley—Wheels.
362. J. Robb and L. Hill, Greenock—Masts and spars.
363. R. J. Mary'on, 37, York-road—Steam-engines.

Dated 19th February, 1855.
364. G. R. Chittenden, London — Measuring fluids. (A communication.)
365. R. A. Brooman, 166, Fleet-street—Capsules for stopping bottles, &c. (A communication.)

Dated 20th February, 1855.
366. G. Tillett, Clapham—Bedsteads.
367. D. Hulett, Holborn—Heating, cooking, and lighting by gas. (Partly a communication.)
368. S. Bellamy, Torquay—Fire-arms and ordnance.
369. C. R. Mead, Langdale-road, Peckham—Gas-regulator.
370. A. L. Thirion, Asche en Refail, Namur—Pumps.
371. H. Schottlander, Paris—Ornamenting looking-glasses.
372. S. Kershaw and J. Taylor, Heywood—Carding engines.
373. J. H. Brown, 4, Trafalgar-square—Ball-cartridges.
375. J. Worthly, Zoffingen—Preservation of meat.

Dated 21st February, 1855.
376. J. Kidd, Kildwick, near Bradford — Stitching machinery.
377. R. Laming, Carlton-villas, Maida-vale — Purification of gas, and obtaining products.
378. B. Goodfellow, Hyde—Pumping machinery.
380. T. Orgun and G. Pitt, Birmingham—Dress fastening.
381. G. Nasmyth, Kennington — Preserving animal and vegetable matters.
382. G. Heppel, Preston—Rotary pump and engine. (A communication.)
383. F. W. Norton, Edinburgh—Warp fabrics.
384. J. H. Pidcock, Leighton Buzzard — Propelling and steering vessels.
386. F. Prince, 3, South-parade, Chelsea—Fire-arms and ordnance.
387. W. Maynes, Stockport—Temples to be used in weaving.
388. G. Noble, Sunderland—Fire-bricks.
389. P. Prince, Derby — Patterns for making moulds for railway-chairs.
390. C. Low, Bodowen, Dolgelly—Extraction of gold from its ores.

Dated 22nd February, 1855.
391. T. Harrison, Hackney—Composition for ships' bottoms.
392. W. Kirrage, 10, Edmund-street, Camberwell — Consuming smoke.
393. R. McConnell, Glasgow—Dressing textile fabrics.
394. J. Bunten and G. Lamb, Glasgow—Cutting and shaping wood.
395. P. Clarke, Manchester — Locomotives. (A communication.)
396. W. Neilson, Glasgow—Locomotives.
397. F. W. East, 214, Bermondsey-street, and J. Mills, William-street, Old Kent-road—Destroying noxious vapours from bone-boiling, &c.

Dated 23rd February, 1855.
398. W. Hartcliffe, Salford, and J. Waterhouse, Manchester—Looms.
399. A. Taylor, 21, Duke-street, Manchester-square—Communication between guard and driver.
401. W. J. M. Rankine and J. Thomson, Glasgow—Laying subaqueous electrical conductors.
402. W. H. Zahn, 13, Norfolk-street, Strand — Windmills. (A communication.)
403. N. Bennett, 7, Furnival's-inn—Substitute for scaffolding. (A communication.)
404. J. E. Gardner, Strand—Portable cooking apparatus.
405. S. M. Allaire, Paris—Hats, caps, and bonnets.
406. B. Looker, jun., Kingston-upon-Thames—Ventilating stables, &c.
407. N. Thompson, jun., New York—Life-boats.

Dated 24th February, 1855.
408. V. J. Lebel, J. Fourniol, and J. B. Remyon, Paris—Typographic presses.
409. B. A. Murray, Dublin—Winding silk, &c.
410. J. H. Johnson, 47, Lincoln's-inn-fields — Fountain pens. (A communication.)
411. J. H. White, Manchester—Artificial teeth.
412. J. Player, J. P. Player, and L. D. Jackson, Winchester-buildings—Drying tan peat.
413. J. S. Russell, Millwall—Water-ballast for ships.

Dated 26th February, 1855.
414. W. Brown, 113, Albany-road, Old Kent-road—Printing.
415. H. Martin and J. Smethurst, Guide Bridge Iron-works, Manchester—Fencing for shafts, &c.
416. A. E. L. Bellford, 32, Essex-street, Strand—Railway-brakes. (A communication.)
417. P. A. Merchant, Paris—Grinding-mills.
418. A. E. L. Bellford, 32, Essex-street, Strand—Soda. (A communication.)
419. J. W. Spurway, 4, Monmouth-place, New-cross—A travelling pass.
420. A. Brown, Tarbet, N.B.—Paper.
421. C. H. Roberts, 3, Cornwall-road, Stamford-street—Rubbers for painters.
422. T. Nash, jun., 134, Great Dover-road—Brushes and brooms.

Dated 27th February, 1855.
423. W. A. Gilbee, 4, South-street, Finsbury—Alcohol. (A communication.)
424. W. A. Gilbee, 4, South-street, Finsbury—Soap. (A communication.)
425. J. Brodie, Bow of Fife, N.B.—Tongs, pliers, vices, &c.
426. A. J. Berchtold, Paris — Applying photographic engravings.
427. H. Gardner, 7, Arthur-street, Old Kent-road—Horse-shoes.
428. J. Cooper, Birmingham—Joiner's braces.
429. B. Fothergill and W. Weild, Manchester — Combing machinery.
430. W. Campion, Nottingham—Knitting machinery.
431. Captain A. T. Blakely, R.A., Little Ryder-street, St. James's—Ordnance.

Dated 28th February, 1855.
433. A. Symons, Strand—Egg cooking apparatus. (A communication.)
435. F. Allarton, High-street, Southwark — Administering iron as a remedy.
436. J. Brickles, J. Thorpe, and J. Lillie, Manchester — Manufacture of fabrics.
437. J. Higgin, Manchester—Treating waste soap liquors.
438. W. Holroyd, Halifax—Fencing for shafts, &c.
439. C. F. Stansbury, 17, Cornhill—Ringing fog-bells. (A communication.)
440. J. Gedge, 4, Wellington-street South—Stopping railway trains. (A communication.)
441. G. M. Miller and J. Wakefield, Dublin—Pistons.
442. B. W. Goode and N. Brough, Birmingham—Fire-arm.
443. F. A. Wilson, Kennington — Closing and unclosing bottles.
444. E. T. Bellhouse and T. Cowburn, Manchester—Vacuum and safety valves.
445. H. C. Jennings, 8, Great Tower-street—Soap.
446. Lieut. T. Cook, R.N., Addiscombe — Working punkas for agitating air.
447. G. Ritchie, New-cross—Dress linings.
448. H. Penney, York-place, Baker-street — Vulcanised India-rubber.
449. B. Blackburn, Clapham-common—Pipes.

Dated 1st March, 1855.
450. R. A. Brooman, 166, Fleet-street — Rollers used in spinning. (A communication.)
452. S. Vigoureux, Rheims—Printing, &c. textile fabrics.
453. T. Sadleir, Tullamore—Manufacturing charcoal.
454. G. M. Miller, Dublin—Railway axles and axle-boxes.
455. A. Small, Glasgow—Marine compasses.
457. J. H. Johnson, 47, Lincoln's-inn-fields — Rolling and shaping metals. (A communication.)

Dated 2nd March, 1855.
458. J. Lewis, Abergavenny—Stench-traps.
459. T. Dodds and R. Leake, 4, Horse Shoe-court, Ludgate-hill, and W. Fletcher, 2, St. James'-street, Old Kent-road—Machine for heating furnaces.
460. G. Lowry, Manchester—Spinning machinery.
461. C. J. Dumery, Paris—Steam-whistles.
462. C. F. Stansbury, 17, Cornhill—Drill and bit stock. (A communication.)
463. J. H. Johnson, 47, Lincoln's-inn-fields—Slide-valves. (A communication.)
464. W. Hodges, Stafford—Boots and shoes.
465. J. Johnson, Bow—Temporary rudders.
466. W. G. H. Taunton, Liverpool—Pumps and their gear.
467. A. V. Newton, 66, Chancery-lane — Printing-presses. (A communication.)
468. J. Correy, Birmingham—Gun-lock.

Dated 3rd March, 1855.
469. J. Woodley and H. H. Swinford, Limehouse — Fire-alarum.
470. A. B. Vabro, St. Thomas'-street East—Floors and roofs. (A communication.)
471. B. Dickinson and J. Platts, Huddersfield—Finishing machinery for textile fabrics.
472. W. Hunt, Tipton—Utilising compounds produced in galvanising iron.
473. T. H. Ryland, Birmingham—Neck and dress chains, bracelets, &c.
474. W. Johnson, 47, Lincoln's-inn-fields—Cleansing and preparing fibrous materials. (A communication.)
475. J. Revell, Dukinfield—Propelling vessels.
476. J. O. Williams, Torquay—Camp stoves and cooking apparatus.
477. T. Metcalfe, High-street, Camden-town — Window-sashes.
478. R. Boby and T. C. Bridgman, Bury St. Edmund's—Corn dressing and winnowing machines.
479. T. W. Carter, Massachusetts—Fire-arms. (A communication.)
480. C. Iles, Birmingham—Polishing, &c. metal substances.
481. C. Iles, Birmingham — Door furniture, castors, and cotton reels.

Dated 5th March, 1855.
483. L. J. Paine, Camberwell, and J. Ryan, Hatcham—Portable utensils for containing liquids.
485. I. Dawson, Northwich—Saddles.
487. R. A. Brooman, 166, Fleet-street — Projectiles. (A communication.)
489. J. Lewis, Elizabethtown, New Jersey — Rigging and sparring vessels.
493. A. E. L. Bellford, 32, Essex-street, Strand—Oscillating steam-engine. (A communication.)

Dated 6th March, 1855.
495. W. Jenkins, Neath Abbey—Casting copper cylinders, &c.
497. G. W. Bowlsby, Castle-hotel, Oxford-street — Closing windage when discharging cannon.
499. A. J. Burr, 42, Alfred-road, Paddington — Gas-meters.
501. E. Tardiff, Bruxelles—Numbering apparatus.

INVENTION WITH COMPLETE SPECIFICATION FILED.

434. J. Reddie, Anstruther, N.B.—Metal shovel. — 28th February, 1855.

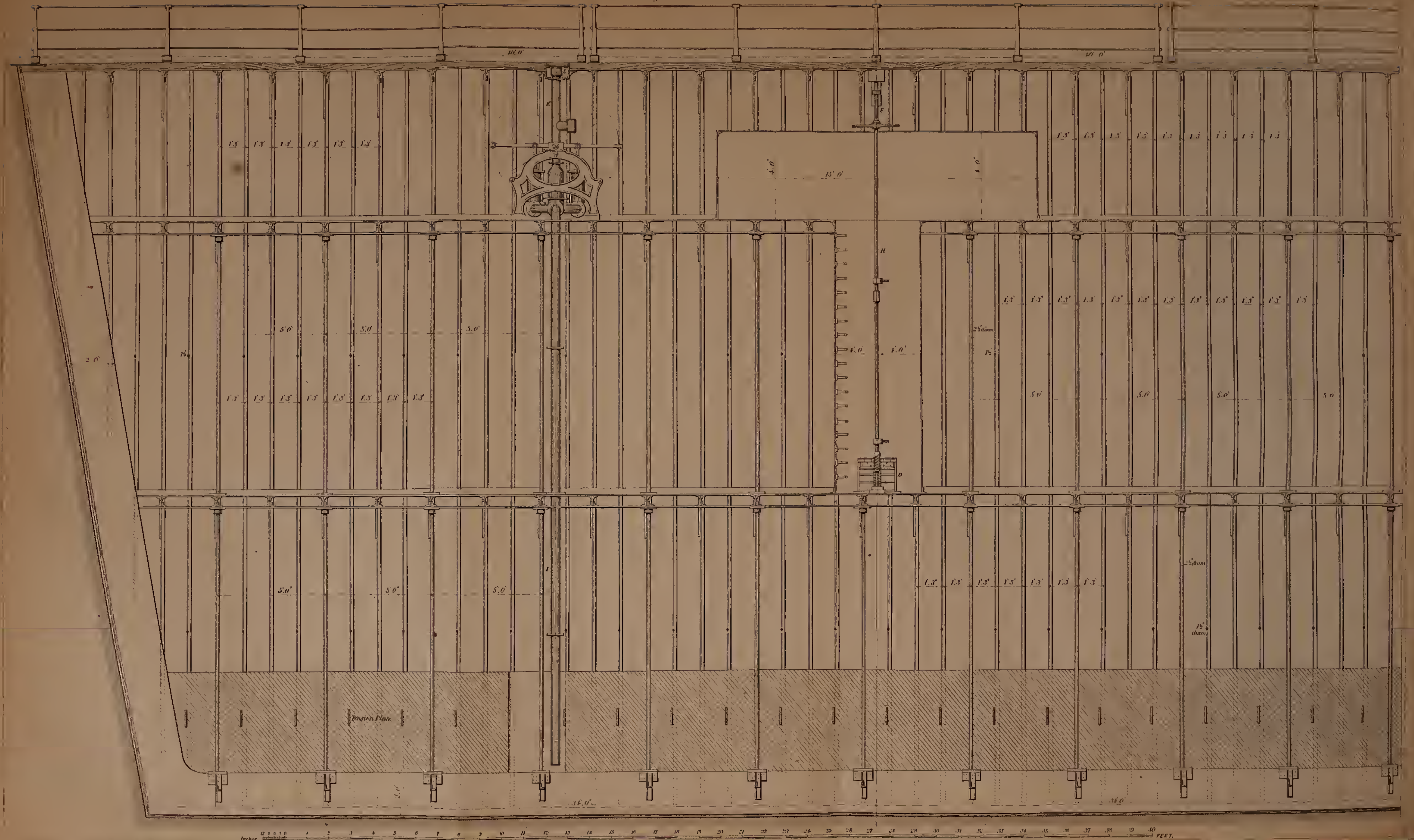
DESIGNS FOR ARTICLES OF UTILITY.

1855.
Feb. 20, 3685. Price's Patent Candle Co., Belmont, Vauxhall, "Price's cooking stove lamp."
" 21, 3686. Oakes and Ward, Birmingham, "Handle and socket for carriage-lamp."
" 22, 3687. Smith and Ashby, Stamford, "Cake mill frame."
" 23, 3688. Price's Patent Candle Co., Belmont, Vauxhall, "Price's cooking stove-lamp."
" 26, 3689. Hinks and Wells, Birmingham, "Pen-holder."
March 2, 3690. J. Rhodes and Co., Holborn Brass Foundry, Nottingham, "Radiating gas-stove."
" 3, 3691. William Plyer Elby, Portsea, "Stays or corsets."
" 7, 3692. John Elce and John Bond, Manchester, "Temple-holder for power-looms."
" 7, 3693. S. Mordan and Co., 22, City-road, "Reservoir protector."
" 8, 3694. James Brook and Brothers, Meltham Mills, near Huddersfield, "Brook's patent glacé thread and universal thread silk preserver."
" 10, 3695. James Deacon, St. John-street, Clerkenwell, "Improvements in beer-engines."
" 20, 3695. Hardy and Jolly, Denby-road, Westbourne-grove, "Letter damper and stamper."
" 20, 3697. William Standring, Rochdale, Lancashire, "Throstle or mule spring for the under clearers of spinning-machines."
" 20, 3698. James Bower Harman, 11, Bucklersbury, "Fixed light oil-burner."

CAISSON AT H. M. DOCK-YARD, KEYHAM.

CONSTRUCTED BY MESSRS H & M.D. GRISSELL.

Regent's Canal Iron Works London




1.3"
5.0"
2.0"
Tension Plate
Inches

ALEX^R. SYMONS' PATENT,

FOR COMMUNICATING SIGNALS FROM GUARD TO ENGINE DRIVER.

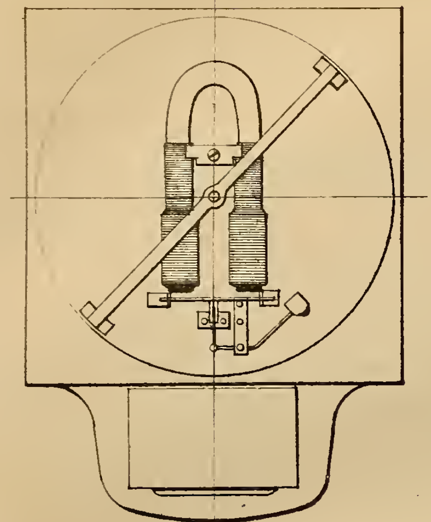


FIG. 1.

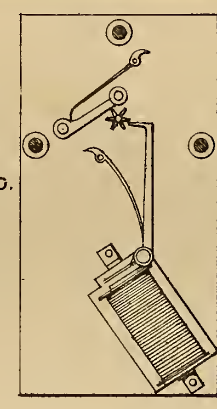


FIG. 3.

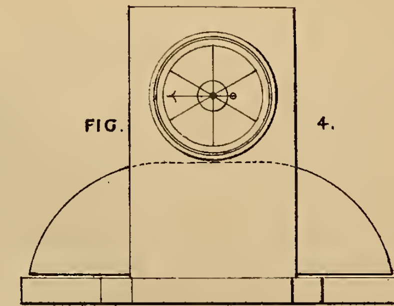


FIG. 4.

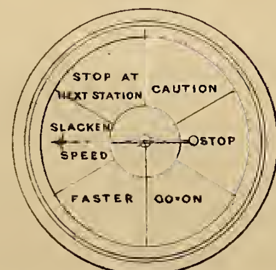


FIG. 2.

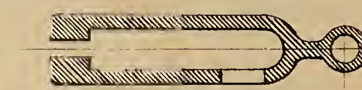


FIG. 7.

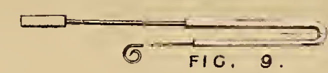


FIG. 9.

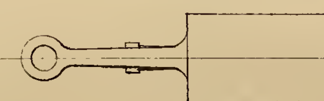


FIG. 10.

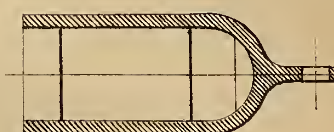


FIG. 8.

FIG. 11.

FIG. 12.

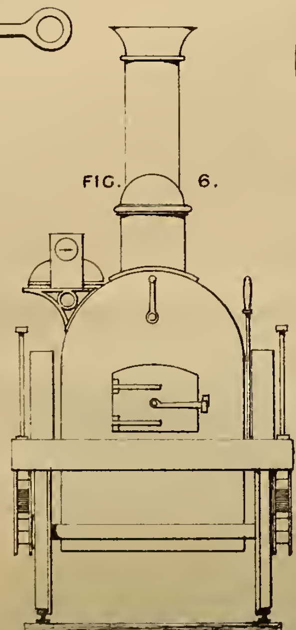


FIG. 6.

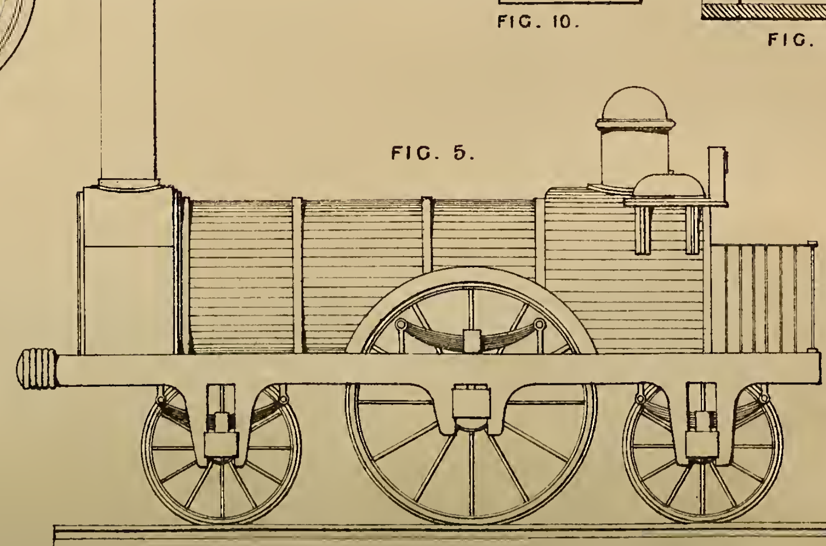


FIG. 5.

THE ARTIZAN.

No. CXLVIII.—Vol. XIII.—MAY 1st, 1855.

THE WROUGHT-IRON CAISSONS AT H.M. DOCKYARD, KEYHAM.

(Illustrated by Plate xxxvi.—continued from page 74.)

Proceed we now to describe the mechanism and the manner of employing it in the management of the caissons, aided by Plates xxxiv. and xxxvi., the latter of which, a longitudinal section, we this month present our readers, Plate xxxiv. of last month being a transverse section across the centre of caisson.

To the sides of the tidal ballast-chamber the sluices A A′ are fixed, each having an area of 4 square feet, and opened and shut by means of gun-metal worms, B B′, and quadrants, C C′, the latter being fixed to the lids of the sluices, which are so constructed as to allow the whole of the water to be run off the floor of the tidal-ballast chamber. These sluices are operated upon from the platform of the bridge over the top of the caisson.

In the inside of the trunk, a sluice, D, is fixed, and constructed in a similar manner to those in the tidal ballast-chamber. This sluice is worked at the top of the tanks in the upper ballast-chamber, as also are the circular valves, E E′, fixed in the bottom of the side tanks.

The rods, F F′, for working the sluices of the tidal ballast-chamber, are passed through pipes, G G′, fixed in the tanks, forming water-tight apertures for the rods, and acting as vents to the tidal ballast-chamber, the air escaping through them as the water flows in, and the air again escaping from the upper ballast-chamber through the scuttle formed in the platform of the bridge.

The rod, H, for working the sluice in the trunk, is steadied by means of two cross-pieces in the trunk, and having bearings formed thereon as delineated; access to these parts being effected by a series of round bars cranked and rivetted to the side of the trunk, and thus forming a permanent ladder.

Three of the caissons, which are situate between basins, are each supplied with a double-cylinder force-pump, placed on the floor of the upper ballast-chamber, for drawing off the bilge-water which may arise from leakage; the suction-pipe, I, being carried down into a well formed in the brick-ballast, and the delivery-pipe, K, being extended up to a box, L, fixed in the planking of the roadway, the delivery-pipe finishing there with a nozzle, to which a hose is attached when the caisson is pumped out, and the bilge-water discharged over the side of the caisson.

For drawing the caisson away from the opening, two ring-bolts for attaching hawsers are fixed to each side of the caisson, about 2 feet 6 inches below the bridge, and about 8 feet from the stems, and secured to the frames inside by means of a cross-plate, clipping two of the frames, and having a chock of timber packed in between the frames, and filling the space between the sheathing-plates and the cross-plate; the whole being firmly secured by the screwed nut of the ring-bolt.

As the construction and mechanism of the caissons will now be fully comprehended, we proceed to explain the principle upon which they are managed and controlled; the credit of which is due to Mr. Scamp, Assistant Director of Works, Admiralty, Somerset-house, by whom these caissons were designed for the Keyham Works.

The caissons were ballasted with brickwork in the lower chamber, until the floor of the tidal ballast-chamber was brought within 3 inches of the plane of flotation, as shown by the water-lines in the transverse section, Plate xxxiv.; the caissons then having the necessary stability and the displacement due to the 3 inches of additional draught between the plane of flotation, and the floor of the tidal ballast-chamber having its proper relation to the contents of the trunk and the tanks in the upper ballast-chamber. This latter point will be particularly observed, as constituting the novelty in the means of managing and working of caissons; for the buoyant effect of this 3 inches of displacement is always present in the caisson, and with every degree of immersion, and the trunk and tanks hold more than sufficient water to overcome this buoyancy and cause the caisson to sink into its groove; and as the tanks are fed from the hydraulic main of the yard, the caissons may be raised or lowered in a very simple and expeditious manner; for, by either running in a little water from the mains, or letting out a little at the sluices, the statical equilibrium is immediately destroyed, and the caisson lowered or raised to the required height in a few minutes.

The *modus operandi* of lowering the caissons, then, is as follows:—The sluices in the tidal ballast-chamber are opened, that in the trunk and the two circular valves in the side tanks are closed, while the tanks, which contain about 60 tons of water, are filled from the hydraulic main; the caisson then gradually descending as the tanks are being filled, until the floor of the tidal ballast-chamber reaches the plane of flotation, when the water will rush into the chamber, and the caisson will then be accelerated in its descent into the groove, because the displacement is nearly constant after the floor of the tidal ballast-chamber has passed the plane of flotation. And when it is required to raise the caisson, the whole of the sluices and the circular valves in the side tanks are opened, when the water in them will, by virtue of the laws of hydrostatics, seek the level of the water in the tidal ballast-chamber, the water in this chamber again seeking the level of the water outside, until the quantity in the tanks and trunk is less than that displaced by the 3 inches of draught already referred to; when the caisson will rise out of its groove, and as soon as the stems are clear of the grooves of the masonry, the sluices may be closed, and the remaining water in the tanks saved, as it is not necessary that the caisson should always rise to the same plane of flotation.

When the caissons are resting in their places, the sluices are all kept closed, and a small self-acting valve is fixed to the side near the high-water line, to admit water to the tidal ballast-chamber from very high tides. This measure is to counteract the tendency of the leakage, from the tanks and their appurtenances, to allow the caissons to rise out of their grooves. Sufficient capacity is, nevertheless, allowed in the tanks to counteract the effects of any additional displacement which may arise during spring-tides; for should the tide rise higher than the roof of the tidal ballast-chamber, it is obvious an additional displacement would be here created, for which this provision is made.

The caisson then rests firmly in its groove when the tanks are filled, the roadway on the top forming a bridge on a level with the adjacent quays for the passage of every species of traffic common to dockyards, the grooves being shielded by W. I. plates hinged to the caisson, and turning down over the grooves, and so protecting their edges and keeping out all dirt. The bridge, we may observe *en passant*, is level longitudinally, but transversely having a rise of 1½ inches in the centre, to allow all water to drip off.

Touching the strength of these caissons, and their capability to resist the head of water on one side of such as are subject to the tide. Experiments were instituted by Mr. Fairbairn, of Manchester, who manufactured the other two caissons required for the Keyham Works; and it was found that with a head of water on one side of 36′·6″ and a clear span of 76′·5″, producing a pressure of 1,400 tons, the side of the caisson was deflected barely 0·625 inch, and it was therefore calculated that the ultimate resistance which the caisson was capable of bearing with safety was 7,000 tons.

PRACTICAL PAPERS.—No. IV.

ON DESIGNING MARINE WORK.

In considering the detail of the shafting plan, the requirements of the thrust-pedestal must be carefully examined, since at this bearing the power of the engines is concentrated, and from it the propelling power is communicated to the ship. The form most approved, and now universally adopted by engineers in this country, was first used by Penn, and its superiority over the many ingenious devices, that have been proposed for the same end, consists in the simplicity and practicability of its design. It has been described at length in the pages of this Journal, but we may briefly say, that it consists of a series of collars, formed on the body of one of the screw-shafts, projecting from ¾ of an inch to 1¾ inches, according to circumstances, and of such a width that the sum of collars and spaces, is about equal to a length not exceeding twice the diameter of the shaft. The collars fit into corresponding recesses turned into the brass, which in large bearings is supported vertically and horizontally by a suitable cast-iron pedestal, fitted often, for the convenience of final adjustment, on a bed-plate attached to the thrust-bearing beam which we described in a former paper.

We shall endeavour to show that the amount of surface on these collars exposed to the thrust of the propeller, when various powers are used, ought to vary directly as the speed of the pistons multiplied by the effective driving load on them, or as the speed of the screw multiplied by the thrust; but that the strength of the pedestal supporting the brass and the size of the holding-down bolts ought to be proportioned to the thrust simply. If we establish these relations, it follows that if the shafts are made in the most approved form, with solid flanges through which to pass the coupling bolts, and with "ways" slotted out of the faces for the driving keys, the area of the bolts will vary as the thrust, and not as the nominal power of the engines. We have been induced to call attention to this point by observing, in many cases, the great number of bolts used in the couplings of marine engines, especially when it is called to mind that the load on our largest pistons has not yet exceeded much more than 70 tons, and that wrought-iron will safely bear a strain of 8 tons per square inch.

To illustrate our meaning, let us suppose that a porter has to carry a given weight up a staircase just strong enough to support him when bearing half that weight. Though he has power to carry up the whole load at once, if there was corresponding stability in the staircase, he is obliged to make two journeys to effect his object in safety. Here the sum total of his bodily wear and tear, may fairly represent the wear and tear of a thrust-pedestal brass, and the necessary strength of staircase may also represent the required strength of thrust-pedestal. If gearing is employed between the pistons and the propeller to increase the number of revolutions, in order to secure the advantages arising from the use of a fine-angled screw, though the same amount of wear is experienced by the thrust-brass as would be caused by using a coarser pitch and diminishing the number of revolutions, yet the actual tendency to force the pedestal back is diminished (or increased) in proportion to the gearing used, further diminished in the proportion of the space passed through by the screw in one revolution to the space passed through by the piston in one revolution of the engines. We shall assume the dimensions of two engines to be as below, and estimate the corresponding thrusts of the screw-shafts, premising that though the loss by friction of engines and screw has been estimated, and in some instances discovered, by the dynamometer to be one-fourth of the whole power of the engines, it is practically safest to disregard this fact. Suppose, then, two pairs of engines to have the following dimensions:—

(1.)	(2.)
Two cylinders of 82½ ins. diameter.	Two cylinders of 82½ ins. diameter.
Stroke, 6 feet.	Stroke, 6 feet.
Gearing, 3 to 1.	Gearing, 5 to 1.
Revolutions of engines per min., 20.	Revolutions of engines per min., 20.
Pitch of screw, 19 feet.	Pitch of screw, 11·4 feet.
Load on pistons, area × 20 lbs.	Load on pistons, area × 20 lbs.

In the first case, the area of the cylinders is 10,691·2 inches: this, multiplied by the load per inch, is 213,824 lbs. moved in one revolution through 12 feet. But the screw makes three revolutions for each revolution of the engine, and the pitch × number of revolutions × thrust = load on pistons × space passed through in one revolution. So 19 × 3 = 57; and since this space that the screw passes through is 4·75 times greater than the space passed through by the pistons in the same time, the thrust must be $\frac{213,824}{4 \cdot 75}$, or about 45,000 lbs. In the second case, it will be found that the pitch of the screw (11·4) is in proportion to the gearing of 5 to 1, as 19 feet is to gearing of 3 to 1; therefore the thrust on the screw-shaft is the same: and if, to run the engine at the same speed, and use a screw of 15-foot pitch or 25-foot pitch, we proportion the gearing accordingly, the thrust will remain the same. But suppose that, with the original gearing of 3 to 1, we substitute a screw of 16-foot pitch, will the thrust then remain unaltered? We should have a screw of a finer angle, and other dimensions remaining the same, more propelling surface, as shown in our number for February; and the calculation of the thrust would stand thus: $\frac{213,824 \times 240}{16 \times 3 \times 20}$ = thrust; or load on pistons multiplied by space passed through, divided by space passed through by screw = thrust, or 53,456 lbs. Here, then, the strain on the thrust-pedestal and holding-down bolts would be about a fifth greater; but as the screw travels through a fifth less space, the wear on the thrust-pedestal brass would still be the same. We find, in practice, that 1¾ square inches per horse-power of thrust-surface is enough to prevent "hot bearings." In some of the large steamers fitted out on the Thames, less than this has been allowed; but we should rather have too much than too little surface on this important bearing. The collars may be proportioned by eye as to width; for, in giving the necessary surface, we shall find that they always greatly exceed in strength the tensile strain that they have to resist; and in commencing the design of a thrust-pedestal, it is convenient to fix the length of the brass at about 1½ or 1¾ times the diameter of the body of the shaft—certainly not more than twice, if possible. The friction of the collars tending to cause the brass to revolve with the shaft, must be met with opponents in the shape of keys, or by one of the devices recapitulated last month as used to keep an ordinary brass from turning, duly allowing for the *extra-ordinary* disposition of the thrust-pedestal brass to take the motion of the shaft. It is the shipbuilder's business to provide a firm support of plate and angle iron, and on this—it facilitates the laying of the shafting in the ship—to bolt a strong bed-plate; on to which, again, between suitable "lugs" or "snugs," a piece of hard wood may be laid; the final adjustment being made by reducing this wood to the proper height, and keying the pedestal between the snugs. The cap against which the flanges of the upper brass bear must be made so that it cannot yield to the thrust or pull of the propeller. This may be very simply effected by carrying up the sides of the thrust-pedestal so high, that the flange of the top brass, being formed square in elevation, may bear solely against the pedestal, the cap being so made as merely to resist the tendency of the top brass to turn or lift.

In the steamers lately fitted by Messrs. Fawcett and Preston, who have almost monopolised the marine engineering in Liverpool during the last few years, the brasses are circular, attached by lugs projecting horizontally at the parting, let into corresponding recesses in the cap and pedestal. The upper part of the pedestal is then bored *vertically*, and the cap is turned to fit well into it; thus, as it were, a solid mass is made of brass, cap, and pedestal; and as the cap-bolts are only exposed to a tensile strain, the holes for them may be cast and the diameter of them reduced in considerable bearings to 1 or 1½ inches, so in the pedestals supporting the shafts, fitted with shell caps, principally to keep dirt from the bearings, and forming excellent tallow-boxes, the diameters of the bolts may be reduced to half what is usually given in proportioning a pedestal for a cotton factory, workshop, or "mill." In fact, when the stern-bush is properly fixed, and the pinion-bearings also securely bolted to their beams, we should feel very much disposed to dispense with caps and cap-bolts altogether, and merely provide what we may call *runners*, for the purpose of preventing the jarring caused by what practical men call the "swag" of the shafts, in shape approximating to the lower half of the trunnion-bearing of an oscillating engine. It is from the manifest absence of any considerable strain upon the pedestals used to support the screw-shafts, that they have by most engineers been made very light. The pinion-bearings, we grant, may be well made substantial: and it is thought advisable by some of our best engineers to provide them with square brasses and wedges, so that as the pinion, by the thrust of the spur-wheel, causes the side of the brass to wear, adjustment may be made without disturbing the permanent keys in the pedestal plate.

In most ships, a material difference would be observed between the working of their screw-shafts and the working of a similar line on land. The alteration in the sheer, or hogging, of a vessel must throw the bearings out of truth; and though some engineers justify the use of couplings strong enough to lift the ship "bodily" out of the water on this ground, it is only saying that the ship is too weak, and in that case the remedy must lie with the shipbuilder. The efficient working of the shafts depends upon the foundation he provides for them: if this is insufficient, it is practically impossible to connect shafts so that they will maintain themselves in truth by their own strength.

A most experienced shipbuilder expressed his opinion on one occasion, that whether the thrust-pedestal was placed in the stern, or midway between stem and stern, was a matter entirely to be regulated by convenience. We have not had the means of investigating this point sufficiently to enable us to assent to, or dissent from, this opinion. We certainly remember, in sundry rafting expeditions, the difficulty of directing a plank to some desired point when applying the propelling pole to the end thereof: but supposing that the ship will steer equally well wherever the thrust-pedestal be placed, we think there would be considerable advantage in expanding the stern-frames of an iron ship at the centre line of the screw-shafts, to such an extent as to admit the thrust-pedestal close to the stuffing-box for the propeller-shaft. The advantages of this arrangement would be, that the stern-bush would be converted into a simple stuffing-box—not a long inadjustable bearing with a stuffing-box at one end, as it is now; that the action of hogging not being felt in this part of the ship, the bearing would be less liable to heat; and last, but certainly not least, we should be able further to reduce the diameter of the wrought-iron flanged couplings, since they might be proportioned only with reference to the transverse strain of the driving power passed through them, the thrust-collars intercepting the tensile strain thrown on bolts and flanges in reversing the engines.

THE STEAM GUN-BOATS AND FLOATING BATTERIES FOR THE ROYAL NAVY.

It is now little more than twelve months since we first entered into the steam gun-boat question, and urged the desirability of supplying the Royal Navy with a vessel-of-war calculated to carry the war successfully into the enemy's own territory; and, as one of the pioneers in the discussion, it has been with no small interest we have watched the progress of the fine flotilla of steam gun-boats which has just left these shores, fitting examples of the resources and the mechanical genius of this country; and the aptitude and promptness which have been exhibited by the heads of the Navy in designing a craft so eminently calculated to meet the present exigency, is as assuring as it is deserving of the highest commendation.

Particulars of the six that were constructed last year will be found in The Artizan, vol. xii., p. 196. Those which have been constructed since have been made about six feet longer, in consequence of finding a scarcity of stowage in the first ones; and their armament has been reduced to one 68-pounder 95-cwt. pivot-gun, and two 24-pounder howitzers. All the engines are non-condensing, by various firms, and marked for their simplicity and compactness.

To reducing their armament, however, we must take exception; and when we state that in each of these gun-boats there has been an expenditure of probably not less than £5,500, and all this for mounting only one effective gun for bombarding operations, the force of our objection to their light armament cannot but be admitted. Had there been two 68-pounders mounted amidships, and arranged to train fore and aft in the manner we suggested (*vide* Artizan, vol. xii., p. 75), this reduction of their armament would have been unnecessary, and their power of attacking end-on have been doubled. With their present construction, taking away one of the pivot-guns is all very well, because it is desirable that gun-boats should be fought end-on, and the one pivot-gun can easily be transferred forward or aft as may be required. We are considering the capabilities of these gun-boats as vessels-of-war only, and independent of their capacity as tenders to larger vessels; and this latter capacity at once suggests the expedient that if the stowage of such gun-boats be not sufficient to supply the means of working two heavy guns, the ammunition could be drawn from a magazine-ship as required, and the men from the vessels to which they are tenders, or from a floating barracks, and thereby have a maximum useful armament with a given expenditure.

Of not less importance as engines of modern warfare are the steam floating batteries, the sea-service mortar-vessels fitted with Captain Julius Roberts' mortars, or rather with his system of mounting mortars, and the *Horatio*, with the two monster guns of Nasmyth—but why fitted to a vessel of such a large draught, we cannot conceive.

The floating batteries are awkward but formidable-looking things, of the following dimensions:—

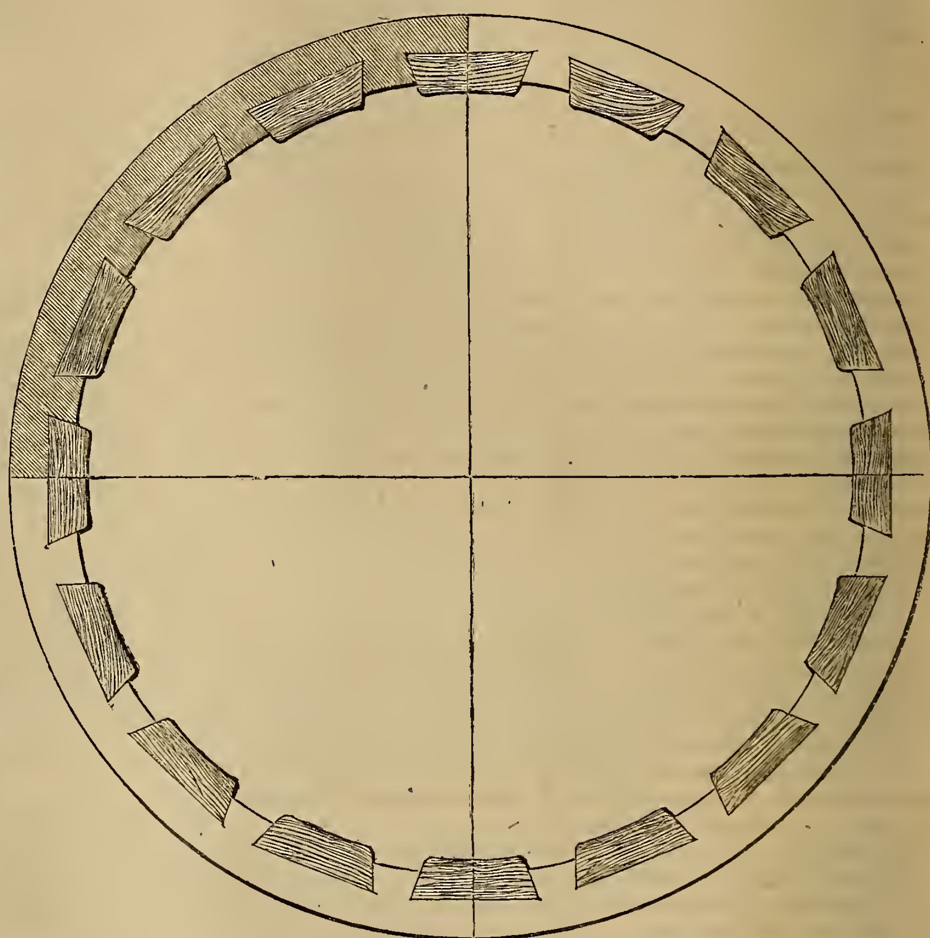
	feet.	inches.
Length between the perpendiculars	172	6
Breadth extreme	43	8
Depth in hold	14	7
Draught	7	9
Tonnage	1469 tons.	

The decks are of 9-inch oak, resting on 10½-in. by 10½-in. beams, placed 1 ft. 9 in. apart from centre to centre, and supported in the middle by stanchions of iron hinged at the top, so as to be struck or hung up when in action. The frames, iron plates, and planking of the sides form a solid mass 2 ft. thick; the iron plates outside being 4 in. thick, planed on their edges, placed close together, and bolted to the woodwork with 1¼-in. bolts. The port-holes are 3 ft. 4 in. by 2 ft. 10 in., and look much larger than absolutely necessary, and too inviting for the aim of the enemy to give us that confidence we could wish: nor can we entertain the opinion that their decks are either shot or shell proof; and why such things as these should be completely equipped and rigged, we cannot, for the life of us, divine. The Admiralty is decidedly masting-mad.

The engines of these batteries are of 150 horse power, non-condensing, and have four tubular boilers with two furnaces in each; the boilers being of a cylindrical form, with flat ends, and capable of working up to a very high pressure. These batteries have been fitted with a screw, 6 feet diameter, in the usual place; but other two, one on each side, will now be added to give more propelling power; the shallow draught and small area of the screw, in consequence of the necessarily small diameter, rendering this addition necessary: for, with a pressure of 60 lbs. to the square inch, and the engines making 130 revolutions per minute, the speed attained was but a little over three knots per hour. We have not time this month to pursue the subject as far as we could wish; but we must again protest against masting such things as these batteries, as only offering targets to the enemy, and giving him the licence to do a maximum of mischief in a minimum of time, by bringing it all down about the ears of those on board, and perhaps silencing the battery entirely, or fighting under the peril of setting fire to the wreck; not to mention the greater number of men which such a system of equipment requires; while their steam-power and other assistance which they might have would surely be sufficient to carry them to the scene of their operations, and then leave them to their steam-power.

WOOD BEARINGS FOR SCREW-SHAFTS.

We are glad to have it in our power to present our readers with the accompanying sketch of the method of fitting shaft-bearings with lignum-vitæ.



½ size.

Among the many recent improvements which have been introduced and matured in connexion with the *screw-engine* and *gearing*, perhaps none will stand higher or be of more value to the practical engineer than this simple, cheap, and effective plan, which we noticed in our last month's Artizan as having been introduced into the *screw*-bearings of Her Majesty's ship *Pembroke*, and other ships.

It will be observed from the sketch, that the brasses are bored out about three-sixteenths of an inch larger than the shaft; then the recesses should be slotted out, to a *template*, for the wood-strips. If care is taken with this part of the operation, any number of strips can be supplied, ready fitted, and the putting in a set of spare strips becomes a short and simple operation.

Being in Portsmouth lately, we were invited by an engineering friend to examine the bearings of the *Malacca*, a 17-gun steam-sloop of 200 H.P. She had been fitted, we were told, in the early part of December last, with wood-strips in her screw-frame. Since that time, she has been out to the seat of war in the Black Sea, and home again; in fact, she has been under steam continuously for nearly three months. Her bearings, when we examined them, looked very well; the screw-shaft (brass) had not a scratch on it, and the tool-marks had not all disappeared from the wood-strips.

In connexion with this subject, it has often struck us, on examining very many of the screw-frames of our screw-ships, that there was an evident want of practical skill and experience displayed in the *construction* of these very vital parts—namely, the bearings of the screw-shaft. In many cases which we could point out, there is an evident treating of such proportions as if they were simply ordinary shafts for transmitting power. Forgetting the great weight of the screw, the reciprocating motion consequent on a two or three bladed propeller, and the intensity of the action connected with these parts, niggardliness in the length and diameter of these bearings has been the source of much trouble and expense. To such constructors the wood bearings will be a great boon.

We could point out two ships within our own knowledge where these bearings have been carefully constructed. In the one ship, the nominal H.P. of the engines is 600 horses, the weight of the screw about 9 tons — making about 70 revolutions per minute. The screw-shaft is covered with brass liners or rings, working in brass bearings. The forward bearing of this screw-shaft is 17 inches long by 18 inches diameter; the total surface, 960·5 square inches. The after bearing is also 17 inches long by 9½ inches diameter; the total surface is 506·6 square inches.

In the other ship, the nominal H.P. is 400 horses; the weight of the screw is not less than 6 tons—making about 50 revolutions per minute. The forward bearing of this screw-shaft is 14½ inches long by 17 inches diameter; total surface, 774·3 square inches. The after bearing is 14 inches long by 9 inches diameter; total, 395·78 square inches.

The screw-shafts and bearings of these ships, thus fitted, have been at work to our knowledge for upwards of four years, and neither show any *perceptible wear.*

TRIAL OF THE "PEMBROKE."

In our last month's Artizan, we were enabled to give our readers an illustrated sketch of the high-pressure boilers of Her Majesty's ship *Pembroke*, of 60 guns. Since that time this vessel has been tried, and her performance has exceeded our highest expectations.

The trial took place in Stoke's Bay, on the 7th April, with the following results :—

Mean speed of engines, 82 revolutions.
Mean speed of ship, 7·6 knots.
Indicated H.P., nearly 600 horses.

We heard it stated, by those who were present at the trial, that the consumption of fuel was under one ton per hour.

In connexion with the trial of this ship, which we have looked forward to with much interest as marking an epoch in marine engineering in this country, we beg to add a few facts, placed in juxtaposition.

We shall take Her Majesty's ship *Blenheim*, which was converted into a steam block-ship in 1847, as offering a fair comparison with the *Pembroke*: both are old 74's, of the same class and nearly the same tonnage, and neither of them have been lengthened to suit the screw.

The *Blenheim*, fitted in 1847.		The *Pembroke*, fitted in 1855.
Nominal H.P.	450	200
Indicated do.	938	600
Speed of ship	5·819 knots	7·6 knots
Weight of engines	98 tons	22 tons
" " boilers	80 "	45 "
Water in do.	56 "	24 "
Screw and gear	30 "	10 "
Load on the safety-valve	10 lbs.	60 lbs.
Consumption of coal per hour, about	32 cwt.	about 20 cwt.
Diameter of screw	16 feet	12 feet
Pitch of do.	20 "	12 "
Length of do.	3 ft. 4 in.	2 "

We can safely recommend the above striking facts as worthy of the most serious consideration of all connected with the progress of marine engineering: they form a *text* for full and ample discussion.

Note.—The facts relating to the *Blenheim* are taken from the table of screw-steamers in Her Majesty's Navy, published by the Admiralty; those of the *Pembroke* we cannot vouch for in every particular, but we are confident that they are very near *the truth*.

SYMONS' PATENT FOR COMMUNICATING SIGNALS FROM THE GUARD TO THE ENGINE-DRIVER OF A RAILWAY TRAIN.

Plate xxxvii. illustrates this invention, which is one of great simplicity, and, as it appears to us, is one which cannot fail to afford those important advantages so much required for the safety of life and property upon railways—and that, too, at so small a cost both for fitting and maintenance, as should insure its adoption by the most money-saving of railway economists.

Electro-magnetism is the power employed to call into action the signalling apparatus; and as its properties are so well understood now-a-day, the economy of its use in this instance need not be entered upon. Suffice it to say, that many improvements have recently been effected in the form of battery, as well as in the materials used therein; that whereas formerly the destruction of the materials in the production of the power was a serious item in the cost of working electro-magnetic apparatus, now the cost of battery-power is but an insignificant matter.

The electro-magnetic bell, of which Fig. 1 is a plan view, is of the simplest construction. The electric circuit being made, by bringing the poles of the battery-wires together, the current is transmitted through the coil of the soft iron magnet, and immediately attracts the keeper to it. This keeper is hinged, as shown in the drawing, Fig. 1, and being connected to the horizontal arm or tail-piece of the hammer, causes the hammer to strike the bell; but immediately the keeper has made contact with the poles of the magnet, the current of electricity becomes reversed, and a repulsion of the keeper from the poles of the battery takes place. The keeper, in falling back, and so withdrawing the hammer ready to give another stroke upon the bell, causes a bent metal spring projecting from its back to reverse the circuit again; again the keeper is attracted to the magnet, and again the bell is struck by the hammer. Thus, a series of electro-magnetic pulsations are produced, in rapid succession, so long as the electric current continues to flow.

In connexion with the bell is another instrument, which appeals as strongly and distinctly to the eye as the bell does to the ear. It consists of a dial mounted in a small case (see Figs. 2, 3, and 4). The case is strongly glazed with glass in front of the dial, to protect it from injury, whilst it enables the signals to be seen distinctly. A pointer hand revolves around the dial, and indicates, by stopping upon any particular signal, what instruction is given by the guard. This pointer hand is acted upon by the same current as the bell; but each time the circuit is made and broken, one signal only is indicated upon the dial, and independently of the pulsations of the bell apparatus. The hand of the dial apparatus is worked in the following manner:—A small electro-magnet is mounted on the frame-plate; the ends of the wires from the two poles are carried through the box, ready to be connected with the circuit wires; a soft plate-iron keeper is hung upon a pivot: this keeper is attached to the shorter end or tail-piece of a detent arm, the upper end or point of which is brought into contact with one tooth of a star-wheel, and by which it is moved through a portion of a circle corresponding to the number of teeth in the star-wheel. This is effected upon the keeper being attracted to the poles of the magnet. The star-wheel is fixed upon the same shaft to which the pointer hand is attached; and as the wheel moves a part of a revolution, so the pointer hand indicates one of the signals engraved upon the dial. The number of such signals depends upon the number of teeth in the wheel. In Figs. 2, 3, and 4, there are six signals, and six teeth in the wheel.

When the current is broken, and the power of the magnet ceases to retain the keeper, a small vent-spring throws the longer end of the detent arm back, the point out of contact with the wheel, and the keeper from off the face of the magnet, ready to be again attracted, and so again move the wheel round one tooth. The pointer is held in its place by a ratchet-wheel and pall.

This, then, is the whole of the mechanism of the apparatus; and nothing can be simpler and less liable to derangement, as will be seen from the fewness of the parts.

The bell and dial are connected together and fixed by brackets on the fire-box of the locomotive engine, close to the driver, as shown in Figs. 5 and 6.

The circuit-wires are fitted in separate lengths under each carriage, with flexible ends, which project therefrom at each end of each carriage. These ends are coupled to the ends of the wires projecting from the next adjoining carriage in the train by means of a suitable metallic coupling, which can be readily connected and disconnected by the porters at the time of attaching or disconnecting the carriages of a train. Two of several simple forms of couplings, proposed by the inventor, are shown at Figs. 7, 8, 9, 10, and 11 and 12.

If railway companies do not voluntarily adopt this or some such simple and efficient apparatus, the Board of Trade ought, for the protection of the public, to be empowered to compel railway companies to do so.

LUBRICATION—MINERAL OIL AS A LUBRICANT FOR MACHINERY.

It will be admitted by every one experienced in the working of extensive steam or other machinery, that to obtain a good lubricating material, possessing all the qualities which will render it fit for general useful application, and, above all, a certain degree of cheapness, is a question of considerable difficulty, and often, indeed, one which the practical engineer and machinist finds quite beyond his means of solution. There can be no doubt that certain of the lubricants at present in use possess a character which, considered in respect to especial applications, places them almost out of the reach of any ordinary substitute; but it must be remembered that these very specialities render such substances unsuitable to general purposes; and it cannot be denied, that any material which is in itself capable of such modifications in process of manufacture as will render it equally suitable to the lubrication of a steam-engine or of the spindles of a cotton-mill, to machinery working with either a high or low degree of speed, is a desideratum in every branch of industry in which mechanical agency is employed. Such qualities as these are claimed for the *mineral oil*, the chemical and physical properties of which we propose to bring under brief review.

When we examine into the question of what the peculiar properties are which it is necessary that a good lubricant should possess, we find the subject dividing itself into two parts—the one relating to the chemical constitution of the lubricating agent, the other to its physical character. With regard to its chemical composition and behaviour, the considerations that present themselves relate, first, to the action of the elements of the lubricating matter, directly or indirectly, upon the metal of which the machine is constructed; and, secondly, to the changes which it may experience in its own constitution by exposure to air or any other influence, as any change in its chemical character produced under such circumstances would, in all probability, immediately affect the question of its lubricating power. Perhaps, in nine-tenths of the cases in which a lubricating medium is employed, at least when the lubricant is in the fluid or semi-fluid state, all the parts of the machinery are composed of metal, either iron, or some form of brass or gun-metal. From this circumstance, it must be at once obvious that the chemical habitudes of the lubricating material towards these metals is a consideration of importance, particularly when the machinery is of a delicate character. It is a very well-known fact, even to those who possess no knowledge of chemical principles or reactions, that when such metals as those named above are exposed to the continued influence of the air, especially if moisture be present, their surface undergoes a peculiar change from the action of the oxygen contained in the atmosphere, with which substance most of the metals can unite, their surface becoming abraded or destroyed as the action progresses. This is termed oxidation.

The power of oxygen to combine with metallic surfaces is very greatly enhanced by the presence of many chemical substances which possess an affinity for the oxide first formed: in that case the production of the oxide will be constantly renewed, and the wear or waste of the metal will be commensurate with the rapidity with which this chemical operation goes on. If, then, a substance possessed in the highest and most perfect degree the physical characters requisite in a lubricating material, but were at the same time capable of acting in the manner just described upon the metal itself, it is manifest that it could not be advantageously employed as a lubricant.

Many of the oils and fats which are employed in greasing machinery undergo spontaneously a chemical change which endues them with the power of oxidising metals, particularly copper, and consequently brass, which is an alloy of that metal. Some fatty substances run more quickly into this condition than others, and the change, when it has proceeded far, is sufficiently marked to be at once recognisable on a very cursory examination of the material. This change is popularly known as rancidity: it consists in the spontaneous conversion of the elements of the fatty substance into acids, which differ according to the nature of the material itself, but which have in all cases sufficient affinity for metallic bodies to establish that action upon the surface to which we have already alluded. In some instances the mere contact of the fatty body with a metal is sufficient to effect a change in it which enables it to react secondarily upon the metal itself. An action of this kind may be seen when a bright piece of lead is kept immersed for some time in a vegetable oil, particularly olive oil: the whole surface of the lead in this case will soon be covered with a thin deposit of an unctuous substance, called by chemists margarate of lead; the first action of the lead being to promote the conversion of the margarine contained in the oil into margaric acid, which then reacting upon the lead, produces the substance described. With respect to the chemical changes of the second kind in which the lubricant may be involved, the circumstances are different. There the lubricant may be totally inactive, so far as its relation to the metal of the machinery is concerned; but, by exposure to air, or from some other influence, it may have been so far chemically changed as to have become thickened or rendered viscid and adhesive, or it might have acquired the property of drying up after a while into a hard, resinous kind of matter: all these changes would, of course, unfit any material for the purposes of lubrication. A certain class of oleaginous bodies have naturally the property of drying when exposed to the air, and many of those which have not naturally this character are rendered thick and tenacious under the combined influence of air and a raised temperature. None of the various materials which are obnoxious to such changes can be placed in the category of substances suitable to the uses of the practical engineer, except in the very roughest kind of machinery; and even then their employment is equivalent to a certain loss of power in the prime moving force.

From what has now been said, it appears, then, that a perfectly good lubricant should combine these definite chemical and physical qualities:—first, it must be incapable of exercising any chemical action upon the metal exposed to its influence; secondly, it must maintain the integrity of its normal chemical constitution under the influence of heat and atmospheric air; and, thirdly, it must, for fine machinery, possess sufficient unctuosity to enable it to interpose a homogeneous medium between the metallic surfaces without flying off, during the rapid motion of any part of the work; while, for heavy machinery, it must, in addition to its freedom from all liability to chemical change, possess that degree of consistency and tenacity which would prevent it from being easily forced out from between moving surfaces by pressure alone. There are few substances which combine these qualities; perhaps those in which they are most conspicuous are sperm oil and the oleine of solid fats: the former may be taken as a standard by which we may judge of the lubricating power of all other fatty materials. Having now, then, in some degree ascertained the points in which the value of a good lubricant consists, we will inquire how far the *mineral oil* can establish its claim to that title.

Some years ago, it was discovered that when the bituminous schales, or schists—which abound in many localities in Europe—are exposed to destructive distillation, they yield a very considerable quantity of a tarry liquid, which, upon re-distillation, furnishes a volatile spirituous fluid resembling coal naphtha, and an abundance of oils, boiling at varying but very high temperatures. At a later period it was found that peat would yield, under similar treatment, oils of a very similar character; and, still later, a further source of these oils, in unlimited quantity, has been discovered in the variety of coal, or more properly schale, which has come into extensive use in gas-making under the name of "Boghead coal." The peculiar character of these oils consists in their containing a large quantity of the subtance called *paraffine*, which is held in solution by a thin oil of low specific gravity, closely resembling, if not identical with, the oil first described by the Continental chemist Reichenbach under the name of Eupion: this oil, from its containing paraffine, is sometimes called, commercially, "paraffine oil." In distilling the Boghead coal with the object of obtaining the oil, particular regard must be had to the temperature at which the distillation is carried on; for it is a remarkable fact, that the nature of these pyrogeuous products varies in an extraordinary manner according to the temperature employed in producing them. In order to obtain the maximum quantity of paraffine oil from the Boghead coal, the heat should not exceed, at any period of the distillation, a dull red, and the process should commence with the lowest temperature at which the tar will distil over. This point being properly attended to, the least quantity of gas and the largest quantity of oil will be obtained: whereas if the temperature rise to a cherry or bright red, the contrary will be the case, as a considerable portion of the oil will be then converted into gas; and not only so, but in the place of paraffine, which is eminently the product of a low temperature, a different substance, napthaline, will be formed, and will, like the paraffine, be held in solution in the fluid oil. In re-distilling the tar to obtain the paraffine oil, the nature of the product varies as the process proceeds: first comes over the thin eupion-like oil, which boils at the lowest temperature; then comes, as the distillation advances, more and more paraffine in admixture with the thin oil, until at length the product solidifies on cooling, in consequence of its consisting almost entirely of paraffine. All these products, excepting perhaps the solid paraffine, are said to be excellent as lubricants under peculiar suitable circumstances—that is, with regard to the character of the machinery in which they are employed.

The oils obtained in this process are of very low specific gravity, ranging from ·790 to ·870. Sperm oil being ·875, they are all more or less unctuous to the touch, and at common temperatures are as fixed as any of the organic oils or fats, boiling only at a temperature approaching that at which the ordinary fats undergo partial decomposition, and then distilling over unchanged.

Having now seen how this mineral oil is obtained, the question arises as to the characters and conditions which render it superior to other substances as a lubricant, or indeed whether such is really the case. A glance at the chemical constitution of this oil will perhaps enable us to form an opinion on one part of the subject.

Referring again to the characters of the ordinary fat oils, we shall find that they consist essentially, in all cases, of certain chemical combinations of carbon, hydrogen, and oxygen, the proportions of which vary slightly according to the nature of the oil; but the specific character of oxygenated compounds belongs to all oils and fats of this class. Such being, then, the chemical nature of these substances, it is obvious that in the element oxygen they contain within themselves the principle of oxidation, and that under the influence of an action which, like fermentation, can establish a tendency to chemical change among their own elements, compounds may be formed, acid or otherwise, without the intervention of external agents; and these compounds may, as we have already seen, possess chemical affinities which enable them to attack and enter into combination with any oxidisable metal with which they may be brought in contact.

Independently, too, of the oils commonly employed in lubrication containing oxygen which might be the means of effecting changes such as we have mentioned, they are themselves all more or less susceptible of oxidation from the influence of external agencies, and the moment this oxidation takes place the normal character of the oil is lost. If we turn now to the consideration of the chemical constitution of the "mineral oil," we find that it differs in one very important particular from the oils or fats of organic origin. It contains, in fact, no oxygen, being a compound of two elementary substances only, viz., carbon and hydrogen. This oil belongs, indeed, to an extensive class of compounds, called hydro-carbons; and so entirely free is it from any oxidising tendency or power, that substances having the most energetic affinities for oxygen, and capable of taking it from any matter in which it exists in combination or otherwise, are perfectly protected from that action by being kept immersed in it. Thus, potassium and sodium—metals whose oxidising tendency is so powerful that they can be only preserved in the metallic state with difficulty—can be kept in the mineral oil entirely unacted upon, and maintaining their brilliancy of surface when freshly cut. There is another point to be considered: the hydro-carbons, and the mineral oil among the rest, have not the slightest tendency to combine with oxygen themselves—at least, under any ordinary circumstances. One of their great characteristics appears, indeed, to be an intense internal conservative principle or force which counteracts any liability to change among their own elements, and which may be even communicated to organic substances placed under their influence, as many, perhaps all, of these substances possess a strong antiseptic power. The substance paraffine, which enters so largely into the composition of this oil, is perhaps the most inert of chemical compounds: it is quite indifferent to other chemical agents, even of the most powerful kind, and cannot be made to form any combinations with them; hence its name (*parum affinis*). As these oils are thus chemically exempt, then, from the influence of the agencies to which they are exposed, they are not only preserved from any change which may cause them to act injuriously upon the metals with which they are in contact, but are likewise incapable of experiencing those changes which cause the common oils to thicken and dry. The consequence of this is, that they physically remain unaltered as lubricants during any length of time, as they appear, from some experiments made in connexion with this part of the subject, to be quite insusceptible of drying when exposed upon a non-absorbent surface. The following results were obtained in testing this mineral oil against other oleaginous matters and their mixtures with the mineral oil itself. The trials were made with the Glasgow oil-testing apparatus (M'Naught's).

Sperm oil, taken as a standard	=	100
Mineral oil, the thinnest kind	=	18
Do. do. containing more paraffine	=	30
Olive oil and mineral oil, equal parts	=	48
Lard oil and mineral oil, equal parts	=	54
Do. do. do. 2 parts to 1	=	63
Refined rape oil and mineral oil, equal parts	=	56

THE BOARD OF TRADE AND ITS NEW METEOROLOGICAL DEPARTMENT.

Investigations concerning the phenomena of the navigable seas, for the purpose of ascertaining the laws which govern them, so as to facilitate navigation and reduce its risks, have been conducted for some time past by Lieut. Maury, of the United States Navy, under the direction of that Republican Government. The success which has justly followed Lieut. Maury's proceedings has induced Her Majesty's Government to listen to the representations that have been made through the Royal Geographical Society, the British Association for the Advancement of Science, and other channels, and grants have been obtained from Parliament for the establishment of a new department under the Board of Trade, for the purpose of pursuing similar hydrographical inquiries. As usual, there has been no difficulty in getting the money; but the leaden hand of incompetent authority, which regards no interests but those of party influence, is operating here, as in every other department of the Executive, to render the liberality of Parliament as inefficient as possible.

Fortunately, merit and experience have combined in this instance with the possession of rank and influence to secure the appointment of Captain R. FitzRoy, R.N., as chief of this new department. But, as we are informed, the very first steps of this excellent hydrographer and scientific navigator, have only served to prove, that he must reduce his comprehension of the duties he has undertaken, to the level of an official system, based upon the most corrupt and selfish patronage. He must not select well-adapted and competent instruments; but he must submit to be clogged by incapable assistants, whose friends have influence enough to force them on the Treasury.

It may be annoying to Captain FitzRoy and the two gentlemen to whom we are about to refer, that this notice should be made public, and we feel bound to say that we are indebted for the information to neither of them; but, desiring to advance the public interests rather than to consult private feelings, we proceed without inviting the consent or opposition of anybody.

When it became known that Captain FitzRoy had been appointed to work out the phenomena of the navigable seas, two gentlemen, strangers to each other and to Captain FitzRoy, communicated with that officer, and made him acquainted with the attention they had respectively given to different branches of the subject, and placed their services and credentials at his disposal. Stipend was no object to either of them; but the opportunity of following out, on a world-wide field, scientific investigations in which they took delight and had acquired reputation, was inducement enough, however limited the means of remuneration at the disposal of the department might be.

We are informed, by an entirely disinterested individual, that Captain FitzRoy fully appreciated the advantages to be expected from the combination of the scientific labours of these gentlemen in assisting to develop his objects—that he represented their qualifications and urged their employment under him in the most emphatic manner; but routine would have its way, and the Captain was informed that he must be content with ordinary clerks, utterly unqualified for the work, not because the incompetent man was cheaper, but because he had friends who could demand such consideration from the persons in authority, who are quite indifferent to every other motive.

We know the importance of the services that Captain FitzRoy's new department is capable of rendering to navigation, commerce, and science; we are aware that the hydrographical data in the possession of this country, placed in the hands of men who are competent to deal with them, would throw immense light on the mysteries of the great deep. It is not because we are less capable than our younger brethren of the United States, or less enthusiastic in the cause of intelligence, that they surpass us, and take the lead where we ought long ago to have opened the way: but we are overridden by corruption in Parliament, in political partizanship, and in the State; and men who will not submit to the sacrifice of independence must be content to bow to circumstances.

We trust that this subject will arrest the attention of our shipping interests, and lead to Parliamentary inquiry.

INVENTORS, AND THE RECORDS OF THEIR INVENTIONS.

By Robert Scott Burn.

Having recently had occasion to institute researches amongst the musty parchments of a public office, the difficulties attendant upon the task—for task such a business most assuredly is—have somewhat forcibly directed our attention to the numerous advantages which would result from the establishment of some system by which papers and documents connected with important branches of social or political economics could be placed easily within the reach of all parties interested.

Take for example the department of mechanical inventions, and let us note the benefits arising to inventors and the public from the institution of such a plan as we have above hinted at: and this will best be effected by tracing very briefly the evil effects which have assuredly resulted from its non-existence in this country.

There is, perhaps, no chapter in the history of our social progress so inducive of melancholy thoughts as that detailing the trials and the sad experiences of inventors. The very term, indeed, coupled with that which conveys so much of dubious honour—genius—is considered by many as synonymous with ruined fortunes and hope deferred. And if the historian can point out brilliant examples of wealth amassed and position attained through the medium of *inventions*, these exceptions do not ignore, but only prove the rule above alluded to. And yet, deriving so much of our national wealth from mechanism and its kindred pursuits, it is scarcely possible to estimate the huge advantages we have derived from this class of the community now under consideration. If the steam-engine is considered by grave historians as contributing in no small degree to the enabling us to maintain our position amidst dangers which threatened our very existence as a nation—to the powers that this wondrous machine gave us in the whirling of the ponderous wheel—in propelling the ocean steamer, that stems the waves with almost equal certainty in the time of stormy tempests as in the gentle breeze—the almost annihilation of time and space in the railway train; add the wonders performed by the mechanism of our factories—whole populations maintained, half the world clothed, by their aid; then, to the grand sum of benefits received, add the multifarious processes—to name which merely would be no small labour now—tending to cheapen comforts, ministering to the wants of every-day life—sending to the "huts where poor men lie" luxuries that kings and princes centuries ago could not command—and ministering with equal facility and open-handedness to the increase of intellectual gifts: then tell us of the debt of gratitude which the world owes to modern mechanism, or name a pecuniary equivalent for the wealth which it has thrown down so lavishly at its feet. Compared with the wonders it has performed—the marvels which its genius has evoked—the most brilliant emanations of the poet's fire seem somehow to sink into comparative insignificance.

And yet, could we but call across the mimic stage of our imaginations the likeness of the men whose potent necromancy has far outstripped the marvellous power of Aladdin's lamp in the Eastern tale, we should behold, not what our fancy might picture—men with bright and hopeful faces and elastic step, but with downcast looks and weary gait—the very images of men who, in their daily life, felt the sickness of disappointment, or the tantalisings of a hope too often deferred.

There is, perhaps, no cause operating so powerfully to maintain this state of things—now, as of old, so drearily disheartening to inventors—as the difficulty there is to ascertain what inventors before them have succeeded in effecting in any particular branch of mechanism to which they may be directing their attention. Unfortunately, the evil resulting from this does not end here, great as it undoubtedly is; but its influence extends further, and takes a wider range. In consequence of the difficulty above alluded to, mechanical improvement of all descriptions is amazingly retarded, and the discovery of new plans or processes, in many cases, rendered nearly impossible. It may be stating a truism—but it is one of those too often neglected because it seems so very simple—when we say that anything which hinders a man from going the right way to his work necessarily hinders its progress. Now, it so happens that the history of inventors has shown us that nine-tenths of their time has been taken up by inventing what others had invented before them, or endeavouring to overcome difficulties which had no existence save in their own imagination, and which by others, who had gone the weary way before them, had been boldly met. Inventors—and this applies to too many—may be said to resemble men setting out on a strange adventure—to traverse a country, the only thing known about which to them is, that it abounds in dangers—intricate paths leading nowhere—labyrinths of difficulties—quagmires, quicksands, pestilential marshes, or beast-infested jungles—but who, nevertheless, have not the means to procure a guide to point out the dangers and how they may be avoided, or how the right path is to be detected amongst the numerous wrong ones which surround them. Indeed, this supposed case very accurately defines the position of inventors as at present existing; the fact being that, while, on the one hand, precious time may be lost, fortunes squandered, character and health thrown to the winds, in the vain pursuit of schemes which are like "the baseless fabric of a vision"—on the other, if the object in view is within the compass of man's capabilities—not hopelessly absurd, like the air-drawn phantasms of the perpetual-motionist—or the work to be done is of great importance, the chances are that the machine or process is invented and reinvented at a vast expenditure of time, health, and money. Nor, indeed, is the evil here pointed out a light one, carelessly to be glanced at, and as carelessly thrown aside as unimportant in its consequences. It is not a question merely of lighter tasks and more hopeful dreams to the inventor—who too often, unfortunately, is unblessed with either the one or the other—but one of far higher social importance to the nation.

Viewing the matter in a purely commercial light—setting down in the one column the cost, *mental* and pecuniary, of mechanism, and, in the other, the gains (in this case pecuniary only) which have accrued to the nation, or to individuals as a component part of it; then strike a balance, and we shall see very clearly the rare money value—which to many minds is the principal point—in fact, "the one thing needful"—which the question above alluded to assumes.

To throw facility in the way of inventors, so that no time may be lost in bringing out any machine or process which the wants of our commerce, the demands of trade, or the requisitions of luxury may necessitate; but that each inventor may, if he chooses, take up the matter just at the point where his predecessor in the career of discovery left off his labours, or by which he can perceive the amount of labour he has to perform, the difficulties he has to overcome, and the dangers to be avoided;—to do this brings about at once a result of so many pounds, shillings, and pence saved—and that, if the proverb tells us true, is so much gained. What the loss is which is sustained by the nation by carrying out a system the very opposite of this, let those say who are capable of judging — men whose palatial buildings are erected and maintained by the profits which mechanism had made for them. For our part, we have no hesitation in recording our belief, that had every facility been thrown in the path of inventors as readily and freely as obstructions were during the last century, we should have been now in a position with relation to our mechanism, possibly, as far exceeding the present as that exceeds the one we held some half-century ago. If we stand amazed in contemplation of the daring conception of our inventors now, and the marvels which their mechanism produces, the mind almost fails to estimate the far greater boldness and the more wondrous power which would probably have been throwing their treasures now amongst us.

Inventors themselves would be the first to appreciate the value of such assistance, nor would the public have long to wait before sharing in the spoils. "As invention," says a high authority — Bennet Woodcroft — "progresses step by step, and is the result of some improvement added to what was before, the value of such information is too great to be duly estimated. Watt did not invent the steam-engine, nor did Arkwright invent cotton-spinning machines; but it is well known that what they did was, first to study the defects of existing machines, and then to add improvements, which not only produced to themselves ample fortunes and abiding fame, but to the country a degree of prosperity which has no parallel in history. In attempting mechanical improvements, the first step should be to learn what machines exist for the same purpose, and what are their defects."

It is needless to say that, up to a very recent period, the taking of this "first step" was to the great majority of inventors almost an impossibility, attainable only by the outlay of a large expenditure of patience, time, and money—commodities, the two last especially, by no means plentiful amongst the fraternity: as for the first, they have much need for a large stock of that.

Suppose a poor man residing in the provinces wishful to know what had been done before him ere setting out on the "patent path," his first expenditure was occasioned by the journey to London. Once there, he doubtless thought his labours were to be easy; but, unless he had an intellect to condense, a knack to arrange, and a memory moreover to retain the various points of information, his difficulties were only about to meet him. Nor, indeed, did these form the only requisites which he had to bring to the task; for, after, by dint of inquiry, he found out the proper office—in itself a labour involving some time expenditure, for there were more offices than one—he discovered, to his dismay, that the documents which he was so anxious to peruse were drawn out on rolls of parchment—hard, unyielding cylinders, having a tenacious tendency to roll themselves up again, and to assume all sorts of wavy surfaces, anything but inducive of that comfort which enables one to "run and read."

But, suppose, by dint of "canny" coaxing, he manages to lay the roll open to his inspection, and to extract the accompanying drawings, which seem as if they had been stitched up in the best possible way to afford the least possible amount of facility for inspecting them—when, lo ! there meets his eye a style of writing—no, such it cannot be—so odd, so angular—so very strange indeed the scratches seem ; can they be some hieroglyphics expressly invented to conceal from prying man the *esoterics* of the Patent Office — the secrets of the roll ? The *hand*, O gentle reader, uninitiated, as we presume you are, in the mysteries, is that barbarous style known only to writers, clerks, and lawyers, as *engrossing*. Ah, indeed ! engrossing, as our poor inventor finds to his cost before he is able to decipher the horrid scrawl. To master these hieroglyphics, and to fathom their mystic meaning, is now his first task. With ready pencil he proceeds to jot down one point of information which he has slowly gleaned, when, lo ! the attendant genius of the musty office steps forward, and, painfully polite, informs the poor inventor that—oh, refined cruelty, mocking misery!—he may read as much as he likes, and commit to memory as much as he likes ; and this he may continue to do so long as his enthusiasm for the search continues, provided always, and be it understood, that this enthusiasm for research does not interfere with the office-hours, and exact minute of departure of the staid officials —for this privilege of punctually closing is one which must not be lightly interfered with—but on no account is he permitted to take written notes, the attendant smilingly suggesting that an "office copy" may be obtained, the meaning of which, and the exact cost of which—for it is an expensive luxury, not attainable except by those who have well-filled purses—may then and there be ascertained. Pocketing up his wrongs—and his money too, if he is a wise man, and at all inclined to speculate in the luxury—he toils away at his most inauspicious manuscript, committing to memory as best he can, and conning his task as a weary schoolboy does, until he fancies he knows the nature of the contents of the roll which he has thus been studying. If patience and his purse are long enough—for each inspection costs a shilling—he pores over the hieroglyphics of another roll. If, after thus discussing two or three—musty mouthfuls, metaphorically speaking, these rolls assuredly are—he proceeds in his leisure hours to note down all he derived from his day's labours, we may set him down as a man of by no means ordinary capabilities, and as having performed a task which, in its kind and degree, may have been as difficult as the inventing or designing of the machine about which he was so desirous to obtain information. But the search of patents in connexion with some of the departments of mechanism involves such an immense amount of labour, that we may look upon it as quite without the reach of the majority of inventors. Indeed, to obtain the mere titles of patents in any department is in itself rather a serious task.

Some idea may now be formed of the difficulties which beset an inventor in his search for information so valuable to him. Doubtless, these difficulties are very much reduced in amount and degree by the practice adopted under the new Patent Act, by which the specifications and drawings of each patent enrolled are printed, and copies sold at a comparatively cheap rate. Moderate, however, as this charge is, it is too much for inventors in many instances to pay, even where they know *how* and *where* to obtain them—which facilities are not too well known. Moreover, this facility of obtaining specifications only extends to the patents granted under the new Act, and we presume that the same labour which we have already detailed is still to be gone through in searching specifications relative to patents under the old ; and this will, we suppose, be the case until the Patent Commissioners, with the assistance of their indefatigable superintendent, Mr. Bennet Woodcroft, are enabled to publish them—a task of no ordinary difficulty, and which will involve the expenditure of a large amount of time and patience.

Some means, therefore, should be adopted to enable these documents to be inspected without charge, and copies taken, if these should be required, by the parties inspecting them. A step of some importance, leading to the consummation of this desideratum, is the recent establishment of a reading-room opened by the Commissioners of Patents, in which all the specifications published under the new Act can be inspected free of charge, and, we presume, copied from if required. It is pleasing to be able to record such an enlightened measure, which cannot fail to be useful.

But the full benefit of the new Act can only be obtained by having copies of every specification forwarded, free of all expense, to the principal town in each county in the kingdom, which could be deposited at little cost, and kept open for inspection in the council-chamber of each corporation. This plan, more or less modified according to circumstances, would, we think, be at once adopted by each corporation if the subject were well ventilated. Possibly, it is so simple, that, like the thousand and one projects so frequently broached, it may never be carried out, but consigned, like them, to the "tomb of all the Capulets" —the capacity of which, by the way, must be enormous, if we are to judge from the amount of things which are so unceremoniously bundled into it.

But, although this suggestion, if carried out, would meet the case so far as the registration of future patents and those taken out since the new Act came into operation are concerned, it leaves the vast mine of knowledge contained in the records of the past totally neglected. To dig this mine—so rich in gems of thought and intellect—would be a difficult, but by no means an impossible task. With much that is totally worthless, and affording only melancholy monuments of man's folly and presumption, and of his true ignorance when deeming himself most wise, there is much that is of rare value. To set aside the worthless and embalm the good, would therefore be the task to be performed. Neither would it involve much expenditure: there are many learned men of high scientific attainments, accustomed to mechanical analysis and description, who would in a comparatively short space of time lay a well-digested *résumé* of the whole of the *valuable portion* of the information now contained in rolls as musty as they are comparatively useless. The pages of our mechanical journals are rife with specimens of what can be done in the condensation of much valuable information into comparatively little space. The work being performed, and the "channels of communication" formerly alluded to being opened up, these "digests" could be scattered throughout the length and breadth of the land. The preparation of such a series of digests in the various departments of invention or discovery would, we think, meet the necessities of the case in a much cheaper and more easily accessible way than that proposed by the Commissioners, in which *every* specification and *every* word are to be indiscriminately printed. This will, of necessity, be a most expensive undertaking, and will involve a large expenditure of time on the part of those who may be searching for information, as they will be obliged to wade through such a mass of matter of comparatively little worth before arriving at anything likely to be useful.

But the dissemination of Patent Office information in the way we have hinted at does not meet the full necessities of the case ; what yet remains to be done will best be shown in the words of Mr. Woodcroft, the present Superintendent of Specifications :—"It would be well if societies, constituted for specific purposes, would undertake to collect, classify, and promulgate all information of value connected with the objects they profess to encourage. * * * Members of Chambers of Commerce would adopt an enlightened policy in lending their aid to extend a knowledge of the elements of invention to those from whom they expect improvements to originate. If each Chamber of Commerce throughout the kingdom were to collect and publish all that is known on the peculiar arts over which it presides, great improvements would necessarily follow. If, for instance, Manchester, Glasgow, and Belfast were to furnish all that is respectively known on the machinery for producing textile fabrics ; Leicester, all that relates to hosiery ; Nottingham, all that relates to lace ; Sheffield and Birmingham, all that appertains to the manufacture of iron, steel, and the products from them—then, for the first time, would the manufacturer and the artizan learn by what steps of both failure and success the machines by which they live and at present prosper have been constructed; and they would thereby also be guided to make such further improvements as would enable their manufacturers hereafter to bear competition with those of other energetic and progressing nations."

If, as some hold, the history of a nation is found written in the records of her *social* progress, what a mine of information might have been opened up by an inspection of such documents as we have referred to! If no other good would be effected by their publication, it would do this: it would give honour to whom honour is due. On the one hand, men with the laurels of a fame around their brow which they had so mendaciously snatched from others now lying in honoured graves, would be consigned to the tomb of forgetfulness which they deserve—or, if remembered at all, only so as those whose deeds were to be deprecated; while, on the other, the men who had fought the battle, and whose the laurels truly were, would hold in the estimation of their fellow-men the place they had so nobly fought for, but whose graves, unfortunately, are like their memories, all forgotten now. Men of fine intellect and rare mechanical genius would be spared the pain and the heart-sickness of sitting by the "chimney-neuk" of poverty—as, alas! so many have done—and of witnessing, the while, other men, blessed with a rare audacity and a shameless face, flaunting in the borrowed robes of their genius, and enjoying the gains which its power evoked.

[Since writing the above, it has been intimated to us that the plan suggested in one part of our Paper, namely, that of sending to the various corporate bodies throughout the kingdom copies of the various specifications as they appear, has been already adopted, or is now in the process of adoption. We trust the report is correct.]

RAMBLES AMONG THE REAPERS.

By Robert Scott Burn.

(Continued from p. 64.)

In last article, in the March number of our Journal, we alluded to the generally-received yet erroneous opinion, that up to a period somewhat later than the date of introduction of Bell's Reaper, no machine had been brought out in America, and mentioned the patent of Jeremiah Bailey, of Chester County, United States, as the first on record in connexion with this department of mechanism, the date being 1823, three years anterior to that of Bell's. We then promised a slight sketch of this patent, which we now present.

The cutting part of the machine consists of six scythes fitted on a horizontal wheel; the edges of these are outward, and when fixed present a complete circle. The wheel is supported by its axis revolving in a gudgeon, which somewhat resembles a "sled-runner" in form. The wheel, with its shaft and "trundle-wheel"—by which it receives motion from the driving-wheel—rises and falls with the inequalities of the ground. The edges of the scythes are kept sharp by revolving in contact with a whetstone. This whetstone revolves on an axis, and along with the scythes. To create the necessary degree of friction between the whetstone and the scythes, its axis is more or less inclined to the line of direction of the revolution, in proportion to the amount of friction required. The whetstone is attached to a sliding rod, which rises and falls with the scythes. The pressure of the "trundle-shaft" and scythe on the ground is regulated by a lever, like a steelyard, which is attached to the top of the shaft, and extended to the tail of the machine, where it is righted according to the nature of the ground and material which are to be operated upon. The horse is yoked in shafts, and walks in front of the left side of the machine, and on the mowed ground. On being cut, the grass is thrown, by the progressive motion of the machine, against a rise in the scythe-frame towards the centre, and then thrown off in a regular row, following the centre of the machine.

In 1845, a reaping-machine adapted to the crops of South Australia was introduced by Mr. Ridley, an ingenious mechanic, resident in that colony. It resembles in construction the reaper already described as used in Gaul at a very early period. "It is something like a cart, pushed forward by two horses instead of being drawn. In front of this machine is a very large steel comb, which is pushed forward by the horses, and seizes the straw of the wheat, as an ordinary comb seizes hair. As the machine moves forward, the straw is, by the motion, drawn through the comb, until the head or part containing the grain is caught in the comb and dragged upwards towards the mouth of the machine. From the peculiar dryness of this climate, the wheat sheds (as it is termed) very readily out of the husk; and, indeed, so much so, that wheat cannot be reaped here in the usual manner without considerable loss from the shedding. As soon, therefore, as the head of the wheat is caught in the comb, the grain is, as it were, combed out, and falls down the comb to the mouth of the machine; that part of the head which does not get through (which is too fine to admit it until the grain has fallen out) is ultimately dragged up to the mouth of the machine, when it is knocked off by an apparatus like that of an ordinary thrashing-machine, and the wheat is then thrashed in the same manner as in other thrashing-machines, whilst the rapid advance of the machine creates a strong draught, by the aid of which the corn is winnowed. The straw is left standing; so much of it as is required for manure, &c., is mown, and the remainder is burnt." This machine, which thrashes and winnows in addition to reaping, is extensively used in the Colonies.

We have already given the titles and dates of the earlier patents granted in this country for reaping-machines, the last of which described being that of Mr. Hobbs, of the Birmingham Theatre: we now finish the chronological list.

On the 31st August, 1830, letters patent were granted to Edward Budding, of Thrapp, near Stroud, (No. 5,989,) "for a new combination and application of machinery for the purpose of cropping or shearing the vegetable surface of lawns, grass-plats of pleasure-ground, constituting a machine which may be used with advantage for that purpose." This machine is the one now almost universally used for the purposes mentioned in the title; at least, it forms the basis of nearly all machines which have been introduced since this date. The cutters are attached to a horizontal cage or drum, which revolves nearly in contact with the ground, and which receives motion from the driving-wheels.

The title of the next patent, being that which was granted to John Duncan, of Great George-street, Westminster, is "for improvements in machinery for cutting, reaping, or severing grass, grain, corn, or other like growing crops or herbs;" the date being November 2nd, 1840, and number of specification 8,668. The cutters of this machine are formed by a series of scythes, curved in their outline, attached to a horizontally-revolving wheel. The cutting edges of the scythes are in the convex side.

(To be continued.)

NOTES BY A PRACTICAL CHEMIST.

Decomposition of Fats.—G. Wilson finds that the neutral fats may be advantageously decomposed, so as to yield glycerine and fatty acids, by maintaining the still at a uniformly high temperature, and admitting a constant current of steam. The temperature needed varies with the nature of the body acted upon, but in no case does it exceed 560° F. Satisfactory results have been obtained with palm oil, cocoa-nut oil, fish oil, animal tallow, Bornean vegetable tallow, and Japan vegetable wax. The fatty acid and the glycerine distil over together, but uncombined, and separate in the receiver.

On the Nature of the Sausage Poison.—Sausages prepared from blood, brains, and liver, occasionally undergo a species of decomposition little understood, and assume highly poisonous properties. The physical changes exhibited in a poisonous sausage are not very striking. Spots of a cheese-like texture occasionally appear; the mass has an acid reaction, and generally a rancid smell. The effects upon the human system are well marked. Digestion, respiration, secretion, and the action of the nervous system are all interfered with. The active principle has not yet been isolated, and many hypotheses have been advanced concerning its nature. Schlossberger, the most recent inquirer, adopts the view that an organic base homologous with ammonia is generated during decomposition. The formation of volatile organic bases is a phenomenon of frequent occurrence during the decomposition of nitrogenous animal matter.

Preparation of pure Carbonate of Potash.—Bitartrate of potash is boiled with an equivalent of carbonate of lime. The liquid is filtered, and acidulated with a trace of nitric acid. Nitrate of silver is then added, to precipitate the chlorides. The filtrate is now again passed through a filter moistened with water acidulated with pure nitric acid, evaporated to dryness in an iron or silver dish, and the residue heated to redness. A few drops of water are sprinkled on the ignited mass, in order to decompose any cyanides which may have been formed. During ignition, the materials should be frequently stirred. The whole is then treated with pure water, filtered, and evaporated to dryness. Thus, we obtain a carbonate of potash perfectly pure, and free from chlorides. Another advantage is, that the tartaric acid is not wasted.

ANSWERS TO CORRESPONDENTS.

"Sanitas."—We have no such simple and unerring test for phosphuretted as for sulphuretted hydrogen. To determine its presence in atmospheric air, we should recommend you to pass, by means of the aspirator, several thousand cubic feet of air through a weak solution of the chloride of tin, to digest with nitric acid, and then test for phosphoric acid in the highly-concentrated liquid.

"M. D."—Your process is faulty. Oxide of cobalt is soluble in an excess of ammonia.

"An Operative Chemist" is advised to become a subscriber to the Cavendish Society.

REVIEWS.

A Dictionary (with Grammar prefixed) of the English Language, as "Spoken and Written." By Hyde Clarke, D.C.L., &c. &c. Weale, High Holborn. 1855.

The Author, in his preface, says, "There are few tasks more thankless and more open to blame than writing on English Grammar, which is as yet unsettled, and must be so while philology is in its childhood, and so little light has been thrown on the philology of the English tongue. Every one, too, has his own way of thinking on English Grammar; and for the one he has taken, the writer of this book asks the kindly feeling of his readers. He has thought it right to look rather to the spoken than the written tongue, and to seek his standard among that body of the Southern English, with whom English has always been a living tongue, and from among whom our greatest writers and speakers have arisen. * * * * * * * *

"As this is a work which will go into the hands of children, and of working men among others, the writer has, so far as he can, put everything in common English, and shunned Latinisms, so that he may be the more readily understood."

Now, however thankless the task of grammar-writing may be considered generally, this Author deserves high praise for the masterly manner in which he has performed his present undertaking.

Paucity of space permits us to say in this number but few words of detail on his able and meritorious performance. A glance, though but cursory, has, however, enabled us to see and to say how he has dealt with some of his subjects. For instance, we see that he has treated—

Ethnology—entertainingly, yet excellently.
Philology—pleasantly, yet philosophically.
Orthoëpy and Orthography—originally, yet ordinately.
The Parts of Speech—particularly sensibly.
Syntax—succinctly and synthetically.
Prosody—pleasantly, and anything but prosaically. And, finally,
Figures of Speech and Figures of Thought—feelingly, yet forcibly and fluently.

There is, perhaps, no subject that requites more abundantly the labour of practical and keen analysis than the English tongue, the history, formation, and sources of which the Author most attractively illustrates.

In an educational point of view, this work deserves the applause of all friends of progress; since, in leading the student by comparison and analysis to examine that with which he should be most familiar—his mother-tongue—it tends to develop his powers of judgment, and to foster a taste for study and research.

That Dr. Hyde Clarke fully recognises the importance of the mission such a work is destined to accomplish, we clearly see. He has not scorned to adapt it to such as find in the terms Ethnology and Philology words lacking a plenitude of meaning, but places side by side pure Saxon exponents—"*Folk-knowledge*" to the one, and "*Speech-knowledge*" to the other; examples which the curators of our museums and public institutions would do well to follow.

Another salient feature is the recognition of the importance of the *spoken* as well as the *written* tongue; a distinction rarely made, yet most patent. To the former Dr. Clarke assigns the first importance, at least for purposes of historical investigation, and most properly; for in the oral traditions of the people, strange as the fact may appear, the character of a tongue is found more strongly and permanently fixed than in the lettered records of its scribes.

This work will, we believe, become to the young as important a step in their educational career, as it will not fail to be to the adult reader seeking to familiarise himself with the vernacular of these realms.

The Year-Book of Facts in Science and Art for 1855. D. Bogue.

This valuable annual continues to gratify us with a store of useful information, even while it shocks us by its mis-arrangement. A notice of the various industrial exhibitions of the past year first meets our eyes. It is a remarkable fact, that, in a mere financial point of view, all expositions of this kind, since the monster gathering in Hyde Park, have proved failures. It is sad that the public curiosity as regards the wonders of practical science and industry is so soon cloyed, whilst attractions of a far lower order continue, century after century, to draw their undiminished crowd of votaries. The future prospects of the Sydenham Palace, in spite of all its fascinations, are, we fear, highly doubtful.

The new Metropolitan Cattle Market is described. Whilst we hail with the liveliest satisfaction the suppression of Smithfield, we cannot but regret the re-creation of private slaughter-houses. Nothing but public *abattoirs*, subject to the inspection of sanitary officers, will ever prove satisfactory.

The strange phenomenon of metals undergoing a permanent expansion by successive heatings has been made the subject of some practical investigations by M. Brix. He finds that furnace-bars require an allowance of 4 per cent. on their length to compensate for this increase.

A great improvement has been effected in the separation of lead and silver. By adding a few pounds of zinc to the ton of mixed metals, the silver is brought up to the surface, and is easily freed from zinc by oxidation.

Impure tungstiferous tin may be readily purified by solution in a granulated condition in hydrochloric acid. If the metal is in excess, no tungsten is dissolved. The solution is decomposed by zinc, yielding fine metallic tin and chloride of zinc. The latter substance, on digestion with milk of lime, yields an oxide of zinc available as a pigment.

The Austrian claim to the discovery of 'nature-printing' is evidently unfounded, since a patent for a similar process was taken out in England as early as 1852. The importance of this art has, however, been in our opinion vastly overrated.

Various improvements are recorded in the art of coating paper or woven tissues with gold, silver, or other metallic deposits.

Under the title 'Manufacture of Ink,' we read,—"A soluble prussiate of *potash* is stated to have been made by treating a concentrated solution of yellow prussiate of potash with iodide of iron containing an excess of iodine." The writer must mean 'prussiate of iron.' This ingenious process for the manufacture of Prussian blue and iodide of potassium was discovered in 1850, and samples were shown at the Great Exhibition.

Of warlike inventions we have a plentiful store. To discover new means of destroying the enemies of civilisation is, however, unfortunately, a far easier task than to secure their adoption and employment.

The deficient supply of materials for the paper manufacture has given birth to a multitude of suggestions, none of which are perfectly satisfactory. We feel convinced, however, that as soon as this important manufacture is released from the hydra-embraces of the Excise, a remedy will appear for this as well as for all its other imperfections.

The consumption or prevention of smoke is, as usual, the subject of numerous projects and patents, many of which have a plausible appearance, and may act satisfactorily under certain favourable circumstances. Not one of them is, however, the plain, universal remedy—the one thing wanted in our great manufacturing towns. We have seen, as yet, no arrangement perfectly satisfactory in the case of small furnaces; whilst, on the other hand, careful firing, without any specific apparatus, sometimes gives results equal to those obtained from the most highly recommended machinery.

Boussingault's process for obtaining oxygen gas by the alternate peroxidisation and deoxidation of baryta is mentioned. We might feel surprised at learning that this process had been made the subject of a patent, did not numerous former examples prove that nothing can be too familiarly known to be claimed, and, if possible, monopolised, by the patent-hunting fraternity.

In connexion with the consumption of lucifer-matches (3,840,000 being produced daily by a single establishment in Paris alone), the idea naturally occurs, whether the enormous consumption of phosphorus thus occasioned will not ultimately exceed the supply. This element, we know, is none of the more abundant, and is, at the same time, a most important item in the formation of animal tissues, and, consequently, in the fertility of a soil. It were to be desired that some other substance rather more abundant could take its place in this important manufacture.

The statistics given concerning the pottery trade are exceedingly interesting. The amount of fine porcelain clay raised in Cornwall and Devon is no less than 50,000 tons, besides about half the quantity of an inferior kind. The total annual value of earthenware made in the United Kingdom is £3,500,000.

On the authority of Professor Crace Calvert, it is maintained that the reason of extracts of tanning matter losing their dyeing properties is, that the tannic acid is transformed into gallic acid.

This work will, in course of time, prove a most valuable source of reference to inventors, and may save much fruitless expenditure of labour by keeping constantly in view what has been already accomplished in every department of practical science.

AMERICAN NOTES.—No. V.

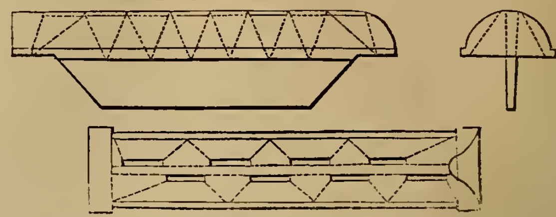
New York and Havre Lines of Steamers.—Cornelius Vanderbilt, Esq., of this city, is about entering upon the route between New York and Havre with a new line of steamers; and until it is practicable for him to build and fit such steamers as can compete in speed and accommodations with those now running upon this route with that success he aims at, he is fitting for the temporary service his two steamers, *North Star* and *Ariel.* The former is the one in which he visited Europe upon a pleasure-trip with his family in 1853 and 1854, and the latter a new one just completed.

The state-rooms of this steamer are provided with Thompson's life-preserving seats, an article conceded to be the most effective of its kind; added to which, it combines with its capacity as a life-preserver, a convenient seat, suitable for the deck, cabin, or state-rooms.

Collins Line.—The proprietors of this line have decided to commence forthwith the construction of a new steamer, to take the place of the *Arctic*, foundered in September last.

Pacific Mail Steam Ship Company.—This Company have commenced the completion of their vessel, that has been in frame and partly planked, at the yard of Messrs. Smith and Dimon, for two years past. Her engines and boilers are to be furnished by the Morgan Iron Works of this city. Her dimensions are like to those of the *San Francisco.*

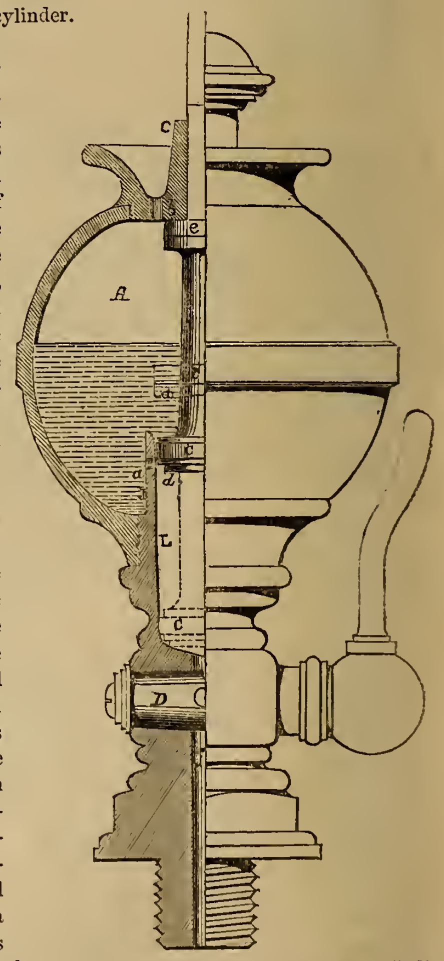
Novel Grate-bars—*Grilles Economiques, Système Roucout.*—This is the designation given to a form of grate-bar lately patented in France and England. In its construction it presents the novelty of having a number of elongated perforations upon the face of the body of the bar, as shown in the accompanying sketch.



I have been put in possession of copies of certificates from twenty manufacturing establishments in France, in which they declare the saving by the use of this bar to have been from 12 to 15 per cent. It is being tested here in the establishment of H. R. Worthington, and in the boilers of the steamer *Star of the West.* Mr. Charles A. Haswell, of this city, is the agent of the patentees in this country.

Treenail Wedges.—Mr. George C. Jones, of Alna, Lincoln Co., Me., has invented a machine for the shaving of treenail wedges, by which they are made *with the grain.* This is considered a useful attainment.

Lubricator for Steam Cylinders and Valve Chests.—The accompanying engraving represents an improved grease-feeder, or lubricator, for which a patent was granted to John Sutton, of this city, on the 16th of January. The oil or grease is forced from a reservoir into the engine by a piston working in a cylinder.



A is the reservoir containing the oil or other grease, in a fluid state; L is the cylinder, and C the piston. The reservoir is supplied with oil through holes, *b b*, in the bottom of a small cup above it. The cylinder is placed in the bottom of the reservoir, with a portion more than equal to the depth of the piston standing above the lowest part of the reservoir, in order that passages, *a a*, through which it has communication with the reservoir, may be left open when the piston is raised above them. The depth and diameter of the cylinder will depend on the quantity of grease to be injected at one time. The piston may be made and packed in any well-known manner: its rod passes through a guide, *c*, in the top of the reservoir, which guide also serves as a vent-tube, and this guide is furnished with a knob or handle; it is also furnished below the guide, *c*, with a collar, *d*, to prevent its being drawn too far upwards; and above this collar, a spring, *e*, of India rubber or other material, is fitted around it to prevent its sharp concussion against the guide, *c*, when the piston is drawn up. Below the cylinder, L, is a tight passage, *f*, leading to the steam-cylinder or other part to be lubricated; and this passage is opened and closed by a common stopcock, D, or it may be fitted with a valve. When the reservoir contains oil, if the cock, D, is shut, and the piston is drawn upwards by hand from the position shown in dotted lines, or anywhere below the passages *a a*, a vacuum will be formed in the cylinder; and after the piston passes the said passages, the oil will be caused, by the pressure of the atmosphere and by gravitation, to rush through the said passages into the cylinder, and fill it. Before opening the cock, for the oil to enter the steam-cylinder or other place where it is required, the piston should be forced down far enough to close the passages *a a*; having done which, its further descent will be stopped by the oil itself. The cock may be then opened, and the piston forced down far enough to drive the whole or part of the contents of the cylinder, L, to where it is required.

By providing the passage *f* with a valve, closing with and opening against the pressure of steam, the turning of the cock may be dispensed with, as the valve will be opened by the pressure produced on the oil in the cylinder, by the force applied to the piston.

Improved Caster for the Adjustment of Tables.—The accompanying engravings represent an improved caster, invented by F. L. Roux, of Charleston, S. C., and for which measures have been taken to secure a patent.

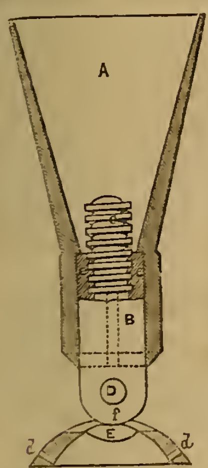


Fig. 1.

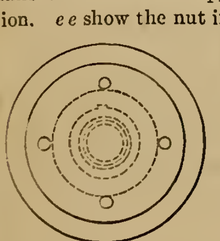


Fig. 2.

Fig. 1 is a vertical section, and Fig. 2 is a horizontal section. A is the half section of the caster, showing the arrangement of the screw and the cavity of the foot of the table-leg. B is the head of the screw, C, with an aperture at D for the reception of a lever to elevate or depress the table. E is a brass cup to receive the head of the screw, as at *f f*; *d d* are holes for screw-nails to secure the cup, E, in a stationary position. *e e* show the nut inserted in the bottom of the cavity of the leg; X X show the junction of the caster.

The nature of the invention consists in the application of the screw, C, to the caster, whereby the table can be elevated or depressed by turning the screw to the right or left, by a lever inserted in D, as has been described. Many tables require to be set perfectly level: by this caster, one can be so set in a very few seconds, a spirit-level being used to true it. By testing a table having these casters on it by a spirit-level, it can always be kept perfectly level. This improvement might be profitably applied to writing tables and desks.

New York and New Haven Steam-boat Company.—This Company are just completing, at the establishment of Messrs. Guion, Boardman, and Co., Eighth-street, a new boat for their line: she will be completed in all this month. The following are the particulars of her dimensions and details of construction:—

DIMENSIONS OF STEAM-BOAT "ELM CITY."

Built by S. Sneden, engines by Neptune Iron Works, New York.

Length on deck	280 ft.
Breadth of beam (moulded)	35 ft. 2 in.
Depth of hold	11 ft.
Hull	1,000 tons.

Kind of engine, vertical beam; kind of boilers, return-flued. Diameter of cylinder, 65 inches; length of stroke, 12 feet. Diameter of paddle-wheel over boards, 34 feet 6 inches. Depth of boards, 2 feet 6 inches; number of boards, 28. Number of boilers, two; length of boilers, 32 feet 6 inches; breadth of boilers, 11 feet; height of boilers, exclusive of steam-chests, 10 feet 3 inches. Number of furnaces, two; length of fire-bars, 8 feet. Number of return-flues, five; internal diameter of return-flues, 1 foot 5½ inches. Diameter of chimneys, 4 feet 10 inches; height of chimneys, 32 feet. Heating surface, 3,556 square feet; area of immersed section, 175 feet; combustion, blast. Draft forward, 5 feet 6 inches; draft aft, 5 feet 6 inches. Masts, none.

Intended service, New York to New Haven.

Remarks.—Floor-timbers, moulded, 16 inches; sided, 11 inches; distance of frames apart at centres, 24 inches.

New York. H.

ON FLOATING CAISSONS AS A SUBSTITUTE FOR DOCK-GATES, THEIR ORIGIN AND SUBSEQUENT IMPROVEMENTS.

The wrought-iron caissons recently constructed by Messrs. Grissell have been partly described at pages 74 and 75, and illustrated by Plate xxxiv. in the April number; and in the present number the construction and mode of working these improved caissons is fully explained, and the subject is further illustrated by Plate xxxvi.

Lady Bentham, the relict of the late Brigadier-General Sir Samuel Bentham, has favoured us with a communication, which will be found in another column, and claiming for the late Sir Samuel Bentham the credit of having originated the idea of closing the entrance of a dock or basin by a "floating dam," or caisson, instead of, as theretofore, by means of lock-gates.

Whilst we are anxious to place before our readers, in a practical form, the most recent improvements in connexion with this as well as every other subject of interest to the engineering and scientific world, and give the credit due to the parties entitled thereto for the talent displayed in designing or in executing such works, we must not withhold from the true originator of a successful design or invention the advantage of a full and fair share of credit; and the spirit of the present day is the more tending to do justice to the suggester of an original idea, the projector of a novel application, or the first inventor of an invention *ultimately successful* and practically beneficial, although such success may, to a great extent, be due to the gradual improvement by subsequent ingenuity, whether applied in the substitution of one material for another, or a variation of form or mode of application induced by practice or from varying circumstances.

The late Sir Samuel Bentham was an eminently ingenious man—one whose talent appears to have been constantly employed, during a long series of years, in devising *practical* improvements in whatever branch of scientific employment he was engaged.

When Sir Samuel Bentham entered the service of the British Government as Inspector-General of Naval Works—an office which was created specially for him, to enable him to effect improvements which he had suggested as being much required in the administration of Naval dockyard matters—he immediately set about practically carrying out his views; and one of the very many practical things proposed by him in early times, as appears by the Admiralty minutes of correspondence and other documents, was the contrivance which he called a "floating dam," to serve instead of gates for keeping water in or out of basins, docks, or locks.

This "floating dam," or caisson, appears to have been devised by Sir Samuel Bentham in 1798, for closing the great basin in Portsmouth Dockyard.

The caisson, as well as the inverted arch with its groove into which the caisson was received, were condemned in the reports of the Comptroller and the Surveyor of the Navy. The Admiralty Board, however, did not accept the opinions expressed in the reports of their Surveyor and Comptroller, but appear to have had great confidence in their Inspector-General's practical skill and ability, for they almost immediately ordered the work to be executed under Sir Samuel's direction.

The early history of this caisson is given in the following letters—extracts of correspondence and minutes:—

Sir Samuel Bentham to Evan Nepean, Esq., Secretary to the Admiralty.

Inspector General's Office, September 10, 1798.

Sir,—I now beg leave to submit, for the approbation of the Lords Commissioners of the Admiralty, the plan of the entrance of the enlarged basin in Portsmouth Dockyard alluded to in my letter of the 4th of last month.

According to this plan, instead of a flat bottom of woodwork, and side walls only of masonry, the whole is of masonry in the form of a reversed arch.

Instead of two pairs of folding gates, one pair for the purpose of keeping the water in the basin, the other for keeping it out, a *floating dam* is made to fit water-tight into a groove wrought in the arch of masonry; by which means the entrance will be shut up, and the water will be kept in or out of the basin.

This floating dam, which is built much in the form of a navigable vessel, is ballasted so as to float at an immersion of somewhat less than 20 feet, whereby, as soon as there is 21 feet water at the entrance, the dam will have risen 1 foot, which is sufficient to clear it out of the groove, so as to admit of its being hauled away.

At the height of 20 feet the vessel is covered with a deck, over which, when the dam is in its place, the water is suffered to flow as soon as the tide has risen to its height. By this means the additional flow of the tide, amounting to about 2 feet at neap-tides, and 6 feet at spring-tides, adds very little to the buoyancy of the vessel, and therefore requires but very little additional weight to prevent its rising out of the groove. From the height of 20 feet, as far upwards as high-water-mark sprig-tides, the water is prevented from passing in or out of the basin by a straight perpendicular bulkhead, erected along the middle of the deck of the vessel, and terminating at each end in what may be called the stem and stern-post of the vessel—these parts being a continuation of the keel; which, together with the stem and stern-post, are all pressed water-tight against one side of the groove formed in the masonry. The bulkhead, or upright part of the dam, is strengthened aloft by a kind of upper deck, which serves as the bridge of communication between the opposite piers.

According to this plan, therefore, the dam across the entrance would, so far as the height of 20 feet from the bottom, be formed by one of the sides of the vessel; while the upper part of the dam for 20 feet upwards, which has to resist the pressure of the water only a few feet below the surface, is formed by the straight bulkhead. The curvature given to the sides, at the same time that it affords a degree of capacity to the vessel sufficient to make it support the weight of the superincumbent bridge, together with a sufficient quantity of ballast to give it stability, enables the sides likewise the better to resist the pressure of the water at the greater depth. What little addition of weight it will require to keep the vessel from rising out of the groove at the time of high water, is to be obtained by letting water into one or more of the cisterns formed in the vessel immediately under the deck. This water would of itself run out of the cistern at the time of low water, even at neap-tides, by means of the penstocks or valves, as shown in the profile; but if after the water has been let in to fill the cisterns, for the purpose of preventing the dam from floating at the top of high water, it should be required to open the gate on the sudden, the water in this case must be pumped out of the cisterns. This, however, would be done in much less time, and with fewer men, than are now necessary to open the basin-gates on *every* occasion.*

I am, Sir, your very obedient servant,
(Signed) SAMUEL BENTHAM.

Evan Nepean, Esq., Secretary to the Admiralty.

From the time of the commencement of the caisson, and the inverted arch for receiving it, until the day of its completion and successful application to its purpose, the Dockyard authorities, as also the less well-informed *employés*, were anxiously looking forward to the trial, and anticipated complete failure of the plan. So, on the day for opening the great basin, and proving the soundness of Sir Samuel's views with regard to his plan for closing its entrance, a large assemblage of persons attended; and many were doomed to disappointment when they found the plan thoroughly successful.

The opening of the great basin is described in the following letter from Mr. Peake, the Master Shipwright of Portsmouth Dockyard :—

Portsmouth Yard, Jan. 12th, 1801.

The great and eventful day is past. Our success is far surpassing my most sanguine expectations. Very early after breakfast, the yard had a wondrous many spectators—admirals, captains, magistrates, surgeons &c. &c.—so that I had really at the docking scarcely room to move; but I think there were very many disappointed ones. You have no conception of the ease and facility with which we performed, not only the caisson, but the docking and undocking. The caisson is now at 21 feet draught of water. I caused 80 men to get on her bridge, all against the rail. It heeled her nearly 7 inches. I shall, therefore, before floating her again, lighten her 18 or 20 inches: she is now over stiff. What is still more satisfactory, the spoon or scraper for cleansing the groove will refuse nothing that may be at its bottom. I, from accident, kicked a large kind of stone, which, luckily, as it happened, went directly into the groove, and sank; which stone, with one or two others, was brought up with other things in the spoon. Depend upon it, all is to your utmost wish.

Brig.-Gen. Bentham, Inspector-General of Naval Works, &c., Admiralty. HENRY PEAKE.

In support of Sir Samuel's claim as the first suggester of this means of closing dock-entrances, the following extracts will go to show conclusively the extent to which we are indebted to that gentleman :—

EXTRACT from Naval Papers relative to various Improvements in His Majesty's Dockyards, by Brigadier-General Sir Samuel Bentham, in a Letter addressed to E. Nepean, Esq., Secretary, Admiralty, 19th Sept., 1799.

(Page 201.)

As, since the time when I first made the proposal for the alteration of the boat-pond and channel, some farther improvements of my plan have presented themselves, I would now beg leave to submit them to their Lordships' consideration.

1st. Instead of gates to keep out the water, and drawbridges across the channel for communication, I would propose floating dams furnished with bridges, on the same principle with that executing for the entrance to the great basin.

Which proposition of a floating dam for closing the entrance of the great basin was made in the letters dated August 4th and 10th, and September 10th and 22nd, 1798.

(Page 203.)

As to the order of proceeding with the work, the first thing to be done would be to prepare a groove across the boat-channel, near the outer end of it, for the reception of a floating dam. This groove would be formed by mean of coffer-dam piles along the bottom, and by cutting out a part of the masonry at the sides. For the purpose of carrying on this work, a temporary fixed dam should be made in the usual way, across the extremity of the narrow part of the channel near the slip. The outer floating dam should be set about immediately, so that it may be ready to be inserted as soon as a proper groove is formed for its reception. When this is done, the fixed dam may be removed.

(Page 204.)

The preparing of grooves for the reception of the other floating dams, the deepening the outer part of the channel, the laying ground-ways, and paving or planking to form the bottoms of the docks, as also the raising the boundary-walls of the pond (a part of them at least of the north side, where there is a slip, so as to form more convenient wharfage), are alterations which may either be pursued immediately, or postponed, as circumstances may seem to require; as each alteration will separately produce its particular advantage.

EXTRACT from a Pamphlet containing a Statement of Services relative to the Improvement and Formation of Naval Arsenals, by Brigadier-General Sir Samuel Bentham.

(Page 53.)

Floating Dams.—S. B. to Sec., A.D. 1798, *Aug.* 4, 10; *Sept.* 10, 22.

4thly. The having contrived and introduced the use of a species of floating dam, to serve instead of gates, for keeping water in or out of basins, docks, or locks.

The first of these floating dams was contrived for closing the great basin at Portsmouth.

The advantages of these floating dams are, that of their being cheaper of construction than the gates theretofore in use for closing basins or docks. They occupy less space; are more easily repaired; and one and the same dam is capable of serving, as need may require, at different places at different times: as, for instance, in the North Camber Docks at Portsmouth, where the same dam is made to serve to close these docks at different parts of their length, as required for one, two, or three vessels. These dams serve also as bridges of communication for loaded carriages across the entrances they close, and require much less labour than gates in opening or closing entrances by means of them, since their occasional bouyancy is effected without pumping water or unloadiug ballast.

These floating dams, under the name of caissoons, have since been adopted in several instances by private engineers.

The original caisson at the great basin, Portsmouth, remained in constant use, without any alteration, and with only a small amount of repairs, for forty-four years ; and it was officially reported that nothing could have answered better, and that no difficulty had ever been found in workiug it. The materials, however, had gradually become decayed, aud it was determined to replace the original caisson with oue of the saue construction.

Space will not permit of our giving more thau these few preliminary remarks upon the subject of caissons in the present number; but we propose next month to continue the subject with an historical account of the progressive adoptiou of this kind of gates for dock-works, and the various improvements which, from the great strides made during the last few years in this aud all similar works, have been effected in their constructiou and arrangemeut, not alone in the Naval and other docks of Great Britain, but throughout Europe and America—giving such illustrations as are likely to be most useful to the professiou : and as the increased dimensions of our shipping involves the necessity for wider entrances to all kinds of docks, the question of the substitutiou of these floating caissous for the ordiuary turning-gates in closing wide entrances of docks is one of much interest.

INSTITUTION OF CIVIL ENGINEERS.

March 20, 1855.

THE paper read was,

ON THE APPLICATION OF THE SCREW-PROPELLER TO THE LARGER CLASS OF SAILING SHIPS FOR LONG VOYAGES,

By MR. R. A. ROBINSON, Assoc. Inst. C.E.

The introduction of screw-propulsion in 1839, by Mr. F. P. Smith, and the success he attained with the *Archimedes*, directed attention to that system for commercial vessels. The *Great Britain* was an early instance of the applicatiou, and then followed the fleet of screw-steamers established by Mr. Laming for the trade between Loudon aud the ports of Holland. Thence the progress was so rapid, that at the beginning of 1854, above two hundred commercial screw-ships were registered in the United Kingdom. Meanwhile, many attempts had been made for using

* Here follows an account of the plans and drawings which accompany the letter.

large powerful screw-ships on the long sea-routes to India and Australia, but uniformly without success. The Author's object was to investigate the causes of this failure, and to suggest the means of attaining success.

It was observed, that hitherto the screw-steamers attempting these long voyages had been large vessels with powerful engines, and, depending chiefly upon their steam-power, had taken more direct routes, independent of wind; and thus, although fully rigged, they had not been able to take full advantage of their sails, but had only used them in favourable winds or in cases of casualty, or falling short of fuel; and when they had been so tried, their sailing powers were not found to be so good as they might have been. Some of these ships had been obliged, by want of fuel, to run back for very considerable distances, because they were out of the usual sailing track: for instance, the *Great Britain* ran 1,300 miles back to replenish her stock, and thus materially extended a voyage which, at its outset, promised to be one of the fastest on record.

Casualties had so frequently occurred, that an impression was given of their being inseparable from the system. This, however, it was contended, was not the case if the machinery was properly constructed and able to work for long periods consecutively. The *Great Britain* was an example of what might be accomplished by due attention to originally good engines and machinery, such as those adapted to this vessel by Messrs. Penn and Son. Out of three voyages to Australia and one to New York, she had never been detained an hour by any derangement of her machinery, which had worked consecutively, on one occasion, for as long as forty-two days without stopping. In the account of her voyages to and from New York in 1852, Mr. F. P. Smith recorded that, under ordinarily favourable circumstances, the ship advanced 5·16 miles per ton of coals, with the slight negative slip of screw = 0·69; and that during three days of strong contrary winds, the ship only ran 2·92 miles per ton of coals, and the slip of the screw was as much as 30 per cent.

The distance from Southampton to Port Phillip, *viâ* the Cape, stemming everything, as a paddle-wheel steamer would do, being 12,030 miles, and the routes of the sailing clipper-ships in the favourable wind track being upwards of 13,800 miles, their relative lengths of voyages were from 60 to 100 days for the former, and 70 to 120 days for the latter.

The quickest recorded runs of screw-ships were those of the *Argo*, of 1,800 tons and 300 H.P., between Southampton and Port Phillip, in 64 days; and the *Victoria*, of 1,853 tons and 450 H.P., between Gravesend and Adelaide, in 59 days 22½ hours, including detentions for coaling.

After examining the records of numerous experiments on screw-vessels, under steam and canvas, steam alone, and canvas alone, the Author argued that one of the principal obstructions to enabling a "minimum-powered" screw-ship, under canvas alone, to compete at all points with a sailing-clipper, was the want of a simple and more efficient mode of lifting the screw-propeller out of the water, and stowing it away at the stern in such a manner as to offer no obstruction to sailing, and yet to enable it to be raised or lowered, in any weather, without difficulty or delay.

The method of disconnecting the screw and allowing it to revolve freely did not meet the objection. Messrs. Maudslay's feathering screw, the blades of which were made to turn so as to bring them nearly in a line with the stern-post, had been applied to several ships with considerable success. The system of lifting the screw vertically out of the water, although effectual, was troublesome, and in a heavy sea-way could scarcely be accomplished. Mr. Scott Russell had introduced a system of raising the screw out of the water, and stowing it away under the counter, with the blades in a horizontal position. The propeller worked outside the rudder; and the after part of the shaft was enabled, by means of a folding joint in the dead-wood, to assume an angular position with respect to the main portion of the shaft, so that it was not necessary for any part to be really unshipped or disconnected, and the propeller could be raised completely out of the water, and be again lowered into its working position, without any difficulty, in the worst weather. It occupied two men about ten minutes to raise it and about three minutes to lower it, the necessary tackle being always attached. It possessed, moreover, the great merit of not imparting that unpleasant, tremulous, and lifting motion to the vessel, so much complained of with the ordinary screws. Comparative trials of vessels of similar build, tonnage, and power, demonstrated a decided gain of speed with the outside propeller.

The Author then examined the voyages of the *Red Jacket*, the *Sovereign of the Seas*, and other celebrated sailing clipper-ships, giving their logs, and showing their speed, on long runs, to be from 8½ to nearly 13 miles per hour. One of this class of ships, of 2,525 tons burthen, was stated to spread about 13,000 yards of canvas in a single suit of sails.

The early attempts to introduce auxiliary power on board East India traders, especially alluding to those by Messrs. Seawards, were mentioned, and the reasons given for their want of success.

Arguing from the speed now attained by sailing clipper-ships, and the successful application of screw propulsion, the Author proposed the employment of iron sailing clipper-ships, of about 3,000 tons, builders' measurement, with large sail power, and so constructed as to attain the highest possible speed, under canvas alone, and, by the aid of screw-propellers and auxiliary engines of 200 H.P., to give them a speed of eight to nine knots, under steam alone, in calm; the supply of coals to be for not less than fifteen days' full steaming; so that a saving of ten to fifteen days might be anticipated in the voyage each way: the sailing power to be always used to the utmost extent, and the ship to be navigated entirely as a sailing-clipper, the steam-power being used only in exceptional situations. By this plan, all the good qualities of the fast-sailing clipper could be secured and combined with the power of steaming at a fair speed, during calms or light winds; and in general this class of ship would attain, at a minimum cost, the best and most uniform rate of speed for long voyages.

The relative expenses of the simple sailing clipper-ship, and of the sailing-clipper with auxiliary engine-power and screw, were examined in detail, and a difference of £4,675 in favour of the latter was shown as the result of one voyage to Australia or India. The logs of several vessels were shown, and, in a tabular form, there were given the speeds attained by all the principal auxiliary screw-ships in use up to the present time.

March 27, 1855.

The discussion on Mr. R. A. Robinson's paper "On the Application of the Screw-propeller to the larger Class of Sailing Ships for long Voyages" being renewed, it was observed, from the statements in the paper, that a special class of commanders of such vessels must be formed, in order to employ advantageously the combined powers of steam and wind: otherwise, in the attempt to bring the propeller to the aid of the sails, injury would probably result.

A fully-rigged ship, with square sails set, whilst on a wind, could rarely lie up nearer than six points from the wind; but with fore and aft sails she came up to within four points. If any auxiliary power was used whereby the speed of such a vessel would be augmented beyond that due to the sails, she would fall away from her course just in proportion to the extra propelling power applied. This had been observed in H. M. steamer *Inflexible*: when using part of her steam-power to aid the sails, and making about eight knots per hour, she passed many vessels, all standing up full two points nearer the wind than she could do; but on ceasing to use steam, she came up even higher in her course, under canvas alone, than the other vessels; and directly the steam was used, she fell off again.

An interesting account was given of the early voyages of the *Red Jacket*, *Blue Jacket*, and the other celebrated clipper-ships, whose arrival in port could be now reckoned upon almost with the certainty of steam-vessels. It was contended, that as a matter of commercial profit, well-appointed sailing-ships were preferable to steamers for the China voyages; but that the latter were most advantageous and comfortable for passengers, especially for voyages not longer than between England and the United States. The American clipper-ships were from 200 to 300 feet long, had fine lines, sharp bow and stern, with a rather flat floor, and carried an enormous extent of canvas. Some of them had been built in a hurried manner for the Californian trade, and had caused an unfavourable impression of that class of ship; but it was stated from authority, that when carefully constructed, at an adequate price, there could not be better, more seaworthy, or drier ships: cargoes of grain had been constantly conveyed without a kernel being wetted. When, however, a vessel of 300 or 400 feet long was built and launched in about four months, it was not surprising that cargoes were damaged. These vessels, with their heavy spars and great spread of canvas, required much care in navigating, and energy and determination were almost as necessary in their Commander as seamanship.

Models were exhibited of the Feathering Screw, adapted successfully, by Messrs. Maudslay, to several vessels, extracts from whose logs were given; whence it appeared, that great benefits, both in speed and convenience, resulted from the use of the system. The same had been experienced on board the *Jason,* fitted by Messrs. Watt and Co.

The Differential-pitch Screw, by which any degree of pitch could be given to the propeller, was shown: it had been found very useful in variable weather, when used on board the *Prince*, which was lost in the great storm off Balaclava.

It was suggested that the displacement of the vessels should have been given in the tables, as without that information it was difficult to compare the results. Shipbuilders ought to give a scale of displacement, for the guidance of merchants in ascertaining the work done by their ships.

An account was given of the early use of auxiliary steam-power, and of a screw-propeller adapted, in 1844, by Captain Hays, to a small vessel in the Irish trade. This, in some degree, led to the introduction of the first feathering screw. More attention was suggested to the position of the masts on board auxiliary power ships, and to their being more especially adapted for using their sails only, and having recourse to the steam-power only under certain circumstances. The *Crœsus* carried a large extent of canvas, but, on account of the improper position of her masts, her sailing qualities had not been fully displayed. The great merit of the differential-pitch propeller was its power of being adapted to suit the sailing speed of the vessel, and thus to prevent the ship from making lee-way. By the late plans of Messrs. Maudslay, the screw could be feathered and unfeathered under any circumstances without any difficulty, and whilst the vessel was taking full advantage of wind and steam. Whenever it was necessary to hoist the propeller out of the water, it was usual to wait some time for the observation of the wind and various circumstances before hoisting; but the operation of feathering the screw occupied so short a time and required so little power, that the Captain never hesitated in making the changes of position five or six times in the course of the day. If this kind of propeller was more used, there would be little doubt of great extension of the auxiliary steam-power system for long voyages.

A suggestion was offered as to the advantage that would result from the accurate statement of the area of the midship section of the ship, and of the indicated horse-power of the engines when describing any vessel: this would avoid much of the ambiguity of the statements frequently put forward. It was notorious that the actual power was from $1\frac{1}{2}$ to 6 times that of the nominal power of marine engines.

It was contended that the system of full-rigged clipper-ships, with auxiliary power and screw-propellers, keeping habitually in the ordinary sailing track and taking full advantage of wind power, had already been acted upon as far as was possible with the *Great Britain*, a ship not originally constructed for the purpose; and that, in a few weeks, the *Royal Charter*, an iron clipper sailing-ship, built expressly with these views, would be launched for Messrs. Gibbs, Bright, and Co., Liverpool. This ship, intended to trade with Australia, would be 2,760 tons burthen, 336 feet long, 26 feet deep, 41 feet 6 inches beam, and 200 H.P., with three masts, square-rigged.

The first voyage of the *Great Britain* had demonstrated the great expense of using full steam-power on the Australian route, and on her return she was, as far as possible, converted into a clipper sailing-ship; instructions being given to her Commander to take the route of sailing-ships on the great circle—to rely more upon sails than steam—to disconnect the screw whenever seven knots an hour could be attained by canvas alone—to work at all times expansively;—in short, to do as much as possible by the sails, and only what was obligatory by steam. The voyage was accomplished in 65 days, with a consumption of 1,393 tons of coal, chiefly anthracite. On the subsequent voyage, acting on the same system, in 60 days she was within 260 miles of Port Phillip; but stress of weather drove her from her course, and she only made the port in 65 days. The consumption of coals was very much reduced, and the fire-bars were uninjured, although the distance run was 14,300 miles. It was remarked that the masts of the *Great Britain* were of necessity not well placed, that her engines were much too powerful, and that, when under sail, her screw acted to some extent as a drag; but, in spite of these disadvantages, the experience gained by her voyages had induced the construction of the *Royal Charter.* This, it was contended, had been publicly known for some considerable time, and to Messrs. Gibbs, Bright and Co., of Liverpool, was due the credit of putting in practice the full-rigged clipper-ship with auxiliary power for long voyages.

The first voyages of the *Great Britain* having shown the advantage that might be derived from giving her more canvas and working the steam-power less on the Australian voyage, her lower yards were made 100 feet long, her topsail yards were increased to 80 feet in length, and her suit of sails was made to contain 14,000 yards of canvas, which was quite as much as was displayed by any clipper-ship. Such were the general qualities of the *Great Britain*, that if the position of her masts could be altered, it was contended she would under canvas alone be probably the fastest ship afloat. She had really run 17 knots per hour when dragging her screw through the water.

The system of lifting the screw bodily out of the water was objected to on the score of liability to accident, although on board some of the ships of war it was a common occurrence to lift the screw in about nine or ten minutes with the power of thirty men at the windlass. It had now been determined to try the system of having a small engine merely to turn round the propeller at a speed corresponding with that of the vessel whilst under sail; and this, it was anticipated, would be a great advantage commercially.

It was urged that the nominal tonnage of vessels and the nominal horse-power of engines were such indefinite terms as to be utterly inapplicable data for comparing the merits of the performance of steam-ships. In order to illustrate the extent of fluctuation of tonnage with reference to displacement, and of nominal horse-power to the effective working power of engines, an examination had been made of the constructive elements of ten ships, all having power in the proportion of 100 tons of displacement to 40 nominal H.P., when the results appeared to be:—That as respected the ratio of tonnage to displacement, 100 tons, builders' tonnage, gave different amounts of displacement, varying between 57 tons and 157 tons. That as regarded the ratio of nominal H.P., as contracted for, to working H.P. of the unit 66,000 lbs. raised one foot high in one minute (or two H.P. indicated), 100 nominal H.P. gave different amounts of working H.P. of the unit (66,000 lbs.) varying from 93 H.P. to 300 H.P.; and, that as respected the ratio of displacement to working H.P (of the unit 66,000 lbs.), the different amounts of working power to 100 tons of displacement varied from 22 H.P. to 185 H.P.

Hence it was argued that the ratio of tonnage to nominal H.P. did not afford any indication of the ratio of displacement to working H.P. of any definite unit.

A doubt was raised as to whether the auxiliary power would ever be found so commercially effective on the long Australian voyage as it had been on the comparatively short passages for which it had been first designed; the question of the currents must be well considered, and it would be long before the best system of navigating such vessels would be completely established. Some objections were raised to the feathering screw, and it was contended that a screw capable of being lifted out of the water in a frame was superior; but it was admitted that a certain amount of power was required for the operation. Hydraulic power might, however, be beneficially employed. The propeller with a rule-joint in the dead-wood was objected to as being liable to accident.

It was a question whether, looking at a comparative chart of the Australian voyages of sailing clipper-ships, it would not be found sufficient to give even smaller auxiliary power—only just sufficient to enable a vessel to work in and out of harbour, do the work of loading and unloading cargo, &c., and let her rely for the voyage almost entirely on her canvas.

On the other hand, it must be considered whether such a condition would not be precisely that of the early auxiliary-power vessels, of which it had been said, "they had just as much power as would get them into difficulties, but not enough to get them out again."

In war-time it might be necessary to run from privateers, and in such cases small power would be utterly ineffective. All these were points to be considered by commercial men, as well as the capability of conveying a certain amount of cargo, at a certain cost, in the shortest period of time.

The valuable assistance of Lieutenant Maury's charts was forcibly alluded to. The difficulty in obtaining details of construction of machinery of the midship section, and of the displacement, &c. of vessels, was pointed out, to relieve the Author of the paper from the allegation that he had not fully supplied all the particulars demanded for the discussion of the question.

It was suggested that, at the next meeting, members should come prepared to discuss the best proportions of steam-power to tonnage,—the best commercial speed,—the means of disposing of the screw, when the vessel was under sail,—the best form of recording observations,—and the general commercial question.

Models were exhibited of Mr. de Bergue's propelling apparatus, the moveable portion of which consisted of a long blade, tapering towards its extremities, to which was communicated, by means of a crank and connecting rod, a motion in a direction nearly vertical to its faces, and at the same time, by means of a radius rod, an oscillating motion on its centre, causing the two faces of the blade to act simultaneously and alternately in an oblique direction against the water, the one acting by compression, the other by suction.

This blade, being enclosed in a submerged case, or chamber, open at each end, produced, by the rotation of the crank, a continuous flow of water through the chamber in either direction.

The displacement of water was very considerable, each revolution of the crank discharging double the contents of the chamber. This apparatus was stated to be applicable as a propeller for steam-boats, or for the displacement of any large body of water, or for a blowing apparatus.

It was stated to possess several advantages over both paddle-wheels and screw-propellers;—in cheapness of construction,—simplicity,—constant effect, from being entirely submerged,—saving in weight,—expending usefully the entire engine-power exerted,—absence of vibration in the vessel,—capability of working in shallow water,—freedom from risk of heated journals, and as being peculiarly adapted for tug-boats, in which latter case the propeller would be placed quite beneath the centre of the vessel, in which position it would also be advantageous for floating batteries and gun-boats.

Models were also exhibited of Griffiths' screw-propeller, which had been used on board the *Great Britain*, and was stated by the late Commander of that ship to have been very successful: the vessel could be sailed with the screw fixed, without much injuring her speed. Recent improvements in the form had further diminished the drag, and there was an almost complete absence of vibration or tremulous motion. The propeller consisted of two moveable blades, inserted in a spherical centre or boss, by which form it was rendered very strong, and the blades could be adjusted to any pitch required by the vessel or engines. It had been fitted to a large number of vessels, and, among them, to H.M. yacht *Fairy*.

Some propellers with curved steps on the blades were introduced by Mr. Walduck, who described the principal advantage to consist in thus obtaining a firm hold upon the water, and retaining it until it passed off at the edges of the blades. Greater speed had been attained, with an almost entire absence of tremulous motion.

ON THE CONSTRUCTION OF RAILWAY SWITCHES AND CROSSINGS.

By Mr. B. Burleigh, Assoc. Inst. C.E.

This portion of the permanent way of railways was shown to require great attention, not only on account of the cost, but for that more important reason, the safety of the travelling public, which was seriously jeopardised by any want of care in the maintenance. It was, therefore, most desirable to insure, in the construction of all parts of the permanent way, the greatest amount of efficiency combined with the largest ultimate economy.

This remark was more peculiarly applicable to the construction of switches and crossings, as they not only formed important features in the system, but they were originally expensive, and were liable to rapid destruction under heavy traffic, whilst corresponding injury was done to the rolling stock by their being in a bad state of repair. With these views, many attempts had been made to introduce improvements, which had been more or less successful. Among those chiefly deserving attention were, Wild's system of housing the tongue-rail of the switch beneath the top flange of the fixed rail; Parsons' solid point-rail switches and crossings; Baynes' switch, with its deep tongue-rail, intended to clear the sliding chairs of any dirt lodging upon them; and Carr's crossing, in which pieces of metal were welded under those portions of the upper table of the wing and point rails most exposed to abrasion and compression. These, although advantageous modifications, were still susceptible of improvement, particularly in the weakest parts, which were the outer rails of the switches, and the wing-rails of the crossings, in the line where the outer edge of the wheels crossed them in a diagonal direction. The severe blows to which these parts were exposed, were caused, in a great measure, by the undulation of the rails during the passage of the weight, which was alternately sustained by the point-rail and the outer rail. The movement or shifting of the relative positions of the various parts of a switch or crossing, resulting from these causes, was most injurious, as the least subsidence of the rail, on which the wheel rested, caused a severe concussion, when the outer edge of the tyre first struck or mounted the adjoining rail, whilst crossing it diagonally. This concussion was simultaneously both lateral and vertical, and being given at a high velocity, and the springs not being able to relieve the axles, wheels, and other parts of the engines and carriages, general injury was occasioned, and to this cause might be attributed the greatest number of accidents arising from fractures of the rolling stock.

A great defect in ordinary switches was the lateral weakness of the tongue-rail, which was sometimes sprung to such an extent by the leading wheel, as to open the point sufficiently for the next wheel to run on to the wroug line, and cause serious accidents.

The importance of attention to these portions of the permanent way would be better appreciated by alluding to the quantity in use throughout the kingdom. This might be inferred from the fact of there being in the London Station of the Great Northern Railway upwards of five hundred sets of points and crossings. In certain situations, under very heavy and constant traffic, and with certain qualities of ballast, the outer rails of some of the switches and crossings were frequently worn out in six weeks by the cutting action of the outer edge of the wheels. It was, however, generally found that a good, sound, and well-drained foundation tended materially to reduce this destructive action.

In the case of a tyre, worn hollow, passing over a switch or crossing, the wheel was actually lifted off the inner rail, and carried on the adjoining rail, resting only upon the outer edge of the tyre, at which moment the concussion occurred, which produced the lateral strain upon the wheel, and the crushing action which channelled out the rail in the path of the outer edge of the tyre.

A want of rigidity was as severely felt in switches and crossings, as in the main portion of the permanent way; and hence the advantages of "fishing" the ends of the rails, so as to secure continuous resistance to the impact of the wheels, and to the insistent weight of passing loads.

Considerable experience and careful observations of these and other minor defects induced the introduction, by the Author, of a switch with a projecting piece, rolled upon the tongue-rail, for supporting the flange of the wheel during its transit over the spot; the surface of the projecting piece being suuk to such a depth below the top of the rail as to correspond with the depth of the flange of a new wheel, which would therefore take a bearing on both the rail and the projecting piece simultaneously. When a tyre was worn hollow, the outer or cutting edge was thus borne up nearly in its original position, and was prevented from cutting into the outer or adjoining rail, which it crossed in a diagonal direction. The surface of the projecting piece was so depressed at its extremity, as to receive the flange of the tyre very gradually, and thus to avoid any concussion; whilst the outer rail was protected from injury, and considerable lateral stiffness was imparted to the tongue-rail. This system had been proved to be very successful practically, and appeared to obviate most of the defects of previous switches and crossings.

The advantages of having extra connecting-rods at all meeting-points, at junctions or stations on the main line, were insisted on; and it was recommended that they should be fastened by a split-key, rather than by a screw and nut.

The frequent fractures of the cast-iron hinge chairs of switches had induced the successful introduction of wrought-iron for the purpose; the hinge being so constructed as to render it almost as perfect as a "fished" joint, and all risk of breakage was obviated.

The introductiou of a filling-piece, or flange-bearer, between the wing and point rails of a crossing, was also shown to be an improvement tending to prevent concussion, whilst it acted as a "fishing" plate for the entire crossing, which was rendered as rigid as a beam. The importance of this continuous rigidity was evident from the cessation of the alternate movements between the wing and point rails, which were usual on the passage of trains, and which caused so much mischief.

The "fishing" plates were rolled alike on both surfaces for the purpose of being reversed; the substitution of wrought for cast-iron chairs insured immunity from fracture and ultimate economy—wooden keys were entirely dispensed with—and after severe trial under very heavy traffic on the Great Northern Railway, particularly in positions where the outer rails had been previously destroyed in six weeks or two months, the switches and crossings introduced by the Author had stood the test of long and heavy wear without exhibiting any symptoms of failure, and the experience already acquired of their properties induced complete confidence in the advantages they presented.

THE SOCIETY OF ARTS' CONVERSAZIONE.

On Saturday evening, the 31st of March, Lord Viscount Ebrington, M.P., Chairman of the Council, received the members and their friends, who assembled to the uumber of about one thousand.

The occasion was the opening of the seventh Exhibition of Recent Inventions.

The museum, library, officers' apartments, hall, ante-rooms, aud the large meeting-room in the Society's house, were each crowded with objects of interest. Mauy uew iuventions, as also some very ingenious contrivances, not patented, were exhibited for the first time on this occasion.

The Society of Arts has done and is doing a vast amount of good, by bringing annually before the public a collection of as many as possible of the inventions or contrivances as have been produced during the year, and contributed by their inventors or proprietors at the Society's request.

It is much to be regretted, however, that inventors as a class appear to be exceedingly careless about availing themselves of such excellent opportunities for exhibiting their inventions; for, when it is remembered that during the year 1854 nearly 3,000 inventions were provisionally protected, it is a matter of surprise that comparatively so very few new inventions are amongst the collection exhibited this year.

The efforts of the Council of the Society should be well supported, and the funds at their disposal greatly increased. This can be best effected by increasing the number of members.

CORRESPONDENCE.

ON THE MAL-ADMINISTRATION OF THE PATENT LAW.

To the Editor of The Artizan.

Sir,—Much as the law appertaining to the granting of letters patent has been improved by the recent enactment, considerable dissatisfaction has been expressed with reference to the manner in which the Patent Law Amendment Act, 1852, is administered by the Patent Commissioners, and other officers connected with the Great Seal Patent Office.

When the Act was passed, it was stated, amongst other things, to be for the simplifying the manner of granting letters patent in the United Kingdom, reducing the cost of such patent, and for giving to inventors the advantage of six months' protection to their inventions at a small cost, during which time they would have the opportunity of putting their invention into practice with perfect safety.

Now, the spirit of the Act is liberal, aud has been the means of enabling a very numerous class of inventors to secure their inventions, and obtaiu from those who have the means and the inclination to support such inventors in their efforts to demonstrate the value of their inventions; but the rules and practices of the Patent Office have practically narrowed the benefit of that part of the Act which gives the inventor the advantage of the six months contemplated thereby to enable inventors to work out and test their inventions, with the option of proceeding to complete their patent, or, if they prefer it, abandoning their invention without further expense than the cost of obtaining provisional protection; for the 12th clause of the Act says, "The applicant for letters patent, so soon as he may think fit after the invention shall have been provisionally protected under this Act, or, where a complete specification has been deposited with his petition and declaration, then so soon as he may think fit after such deposit, may give notice at the office of the Commissioners of his intention of proceeding with his application for letters patent for the said invention; and thereupon the said Commissioners shall cause his said application to be advertised in such manner as they may see fit; and any persons having an interest in opposing the grant of letters patent for the said invention shall be at liberty to leave particulars in writing of their objections to the said application, at such place, and within such time, and subject to such regulations as the Commissioners may direct."

But the Commissiouers, by their rule 6 of the third set of rules, say, "In the case of all petitions for letters patent left at the office of the Commissioners after the 31st day of December, 1853, the notice of the applicant of his intention to proceed for letters patent for his invention shall be left at the office of the Commissioners eight weeks at the least before the expiration of the term of provisional protection thereon; and no notice to proceed shall be received unless the same shall have been left in the office eight weeks at the least before the expiration of such provisional protection."

Now, this rule is clearly not made in accordauce with the true spirit of the Act, and is contrary to the 3rd clause of the Act 5th & 6th Vic., cap. 83, which says, "It shall be lawful for the Commissioners from time to time to make such rules and regulations (not inconsistent with the provisions of this Act) respecting the business of their office, and all matters and things which under the provisious hereiu contained are to be under their control and direction, as may appear to them necessary and expedient for the purposes of this Act; aud all such rules shall be laid before both Houses of Parliament within fourteen days after the making thereof, if Parliament be sitting; and if Parliament be not sitting, theu within fourteen days after the next meeting of Parliament. And the Commissioners shall cause a report to be laid annually before Parliament of all the proceedings under and in pursuance of this Act."

The 5th rule of the first set of rules made by the Commissioners, and dated 1st October, 1852, determines that within twenty-one days after the notice of intention to proceed is advertised in the "Gazette," the patent may be opposed, but if not opposed, may be sealed forthwith.

Now, it may be contended by the officials, that two months is not too much time to allow for the twenty-oue days' time from date of publication of notice, as also to enable them to do their part of the work, viz., for preparing the warrant and seal: but *one hour* has sufficed for the preparation of the warraut and sealing the patent, and there is, it is believed, no reason why *one day* should not suffice for that purpose.

The 6th rule of the third set of rules proceeds to state,—"and the application for the warrant of the law-officer aud for the letters patent must be made at the office of the Commissioners twelve clear days at the least before the expiration of the term of provisional protection, aud no warrant or letters patent shall be prepared unless such application shall have been made twelve clear days at the least before the expiration of such provisional protection: Provided always, that the Lord Chancellor may, in either of the above cases, upon special circumstances, allow a further extension of time, on being satisfied that the same has become necessary by accident, and not from the neglect or wilful default of the applicant or his agent."

Why "twelve clear days at least" should be required for the purposes named, is a matter of surprise. Be it remembered, that upon giving the notice to proceed, as well as applying for the warrant and seal, involves the payment at the time of application of the sum of £5 for each of these three steps, together amounting to £15. Now, these payments by a poor inventor are to him important matters, and instead of having six months clear within which to try his invention, without expending any sums beyond the cost of obtaining provisional protection, he is called upon within four months to pay at least £5, or, in default, his patent falls to the ground, and is valueless at the end of the six months. This is also the case if the £10 for the warrant and seal be not paid for "twelve clear days at least before the expiration of the term of provisional protection."

The inventor, it will therefore be seen, has not six months, but really less than four months; and in some cases, in consequence of the delay which arises in getting the provisional papers from the office of the Attorney or Solicitor General—arising from the various causes which operate against those gentlemen giving the papers the prompt attention which should in all cases be given—the time occasionally (and particularly at certain periods in the year, as during the assizes) becomes shortened to three months between the appearance of the patent in the list published in the "London Gazette," and the period at which the notice to proceed must be given and the money paid.

The proviso at the end of rule 6 of the third set of rules—viz., "Provided always, that the Lord Chancellor may in either of the above cases, upon special circumstances, allow a further extension of time, on being satisfied that the same has become necessary by accident, and not from the neglect or wilful default of the applicant or his agent"—has, it is said, rarely if ever been exercised; but, on the contrary, a severe adherence to the rule has been insisted upon by the officers of the Commissioners, who have discountenanced every attempt to seek from the Commissioners the advantage of the provision, in cases where "accident, and not the neglect or wilful default of the applicant or his agent," has been the cause of omission. Very strong and honest cases of this character have been represented by petitions; but the invariable result has been a refusal to grant the prayer of such petitions, and the endorsement on such petitions, "No Order—Cranworth C.," has become stereotyped.

With reference to the treatment of petitioners in such cases as are contemplated by the Act, it is understood that, in consequence of the very numerous complaints, active measures are being concerted to have matters relating to petitions more fairly dealt with.

As to the practice of hearing oppositions to the granting of letters patent, it has been found that much inconvenience and delay occur in cases of a complicated and important character, and frequently give rise to the necessity for several hearings; and when such hearings are attended by counsel or a professional adviser, the expenses entailed upon the applicant or opposer become very heavy; for it is the practice with one of the law-officers to charge for each hearing, as well as to charge fees exceeding those ordered by the first set of rules, dated 1st October, 1852. Here, then, is a difference of practice between the law-officers, and possibly, after three hearings by the Solicitor-General, the matter may be referred to some scientific person whose opinion may be opposed to the opinion previously entertained by the law-officer, yet the scientific opinion may prevail,—as, indeed, has recently occurred.

Another defect in the present system of business pursued by the officers in the Great Seal Patent Office, is not giving a *certificate* of deposit of provisional papers *at the time* of receiving them.

Again, the clerk should give a certificate of having received the amount of stamps duty, and fee for the warrant and seal. This receipt should contain the name of patentee, title and date and number of patent; and being given at the time of receiving the fees, &c., would prevent mistakes on either side, which have occasionally occurred, and thereby endangered the loss of the patent.

Another matter which requires attention is the unreasonably long interval which occurs after the passing of the provisional paper by the law-officers before its publication in the "Gazette;" also between the leaving of "notice to proceed," and its appearance in the "Gazette."

The great delay which has hitherto taken place in printing the specifications is being remedied to a certain extent; but there is still much room to complain. Three months is too long a time to be permitted to elapse after the six months have expired, remembering that many patents are specified at four or five months.

There are several other points upon which I may trouble you next month.

C. E.

ON CAISSONS.

To the Editor of THE ARTIZAN.

SIR,—As your chief object appears to be that of affording to your readers just grounds for determining the best mode of constructing caisson gates, and as that of Mr. Scamp seems to be the only one in competition with that of Sir Samuel Bentham, it may be useful to compare the one mode with the other. It seems, however, necessary to premise that the engraving in this month's ARTIZAN is of a caisson the form of which is that of a navigable vessel, whereas that caisson claimed by Mr. Scamp as of his invention is a rectangular box, as described by Mr. Fairbairn in his paper read to the Institute of Civil Engineers; and that the following comparison is confined to Mr. Scamp's rectangular caisson with the caisson of General Bentham, as exemplified in his drawings of 1798, which two years later was completed and in use in Portsmouth Dockyard: further, that the modifications you speak of were confined, it may be said, to such alterations as were requisite according to different depths and breadths of the entrance to be closed. For instance, the caisson for closing the great basin at Portsmouth is longer, and broader, and deeper, than that for closing the boat camber-docks in the same yard, both of these caissons having been planned by General Bentham.

To proceed to the comparison of Mr. Scamp's caisson with that of Sir Samuel Bentham:—

Mr. Scamp's caisson is of iron: the caisson invented by Sir Samuel in the year 1798 was of wood, iron at that time having been much more costly than timber. Iron, of late years, had been largely used for caissons before the construction of that for Keyham Dockyard.

Buoyancy is given to the Keyham caisson by air confined in air-tight chambers. In the caisson of 1798, buoyancy was obtained by the shape of the structure, it having somewhat resembled that of a navigable vessel.

To sink the Keyham caisson, water is employed, for the reception of which tanks are constructed within the caisson. In the caisson of 1798, water was employed for the same purpose; but it was allowed to flow over a deck in the most simple manner, that deck having been divided by a longitudinal bulkhead, to provide for the different circumstances of keeping the water up in the beam, or its exclusion from it.

In the Keyham caisson, *valves* are employed for the admission of water, or for its exclusion. In the caisson of 1798, *valves* were employed for the same purposes. It may be observed, that in this caisson of 1798, by means of these valves, and other arrangements for the easy influx or efflux of water, the need for pumping was avoided.

In case of extraordinary emergencies, such as the need for suddenly opening the basin at high water, it does not seem that any provision has been made in the Keyham caisson. In the caisson of 1798, tanks were made for the reception of water, which, on such rare occasions, had to be pumped out: otherwise, no pumping was necessary. Indeed, it does not appear that, during thirteen years' service of the caisson of 1798, pumping had ever been needed, nor is there any known occasion of its having afterwards been required.

The Keyham caisson, when opened, is drawn into a recess purposely provided for it in the basin-wall. The caisson of 1798, when not in use, could be placed where least in the way, either within the basin itself, or without side of it in the harbour.

The Keyham caisson requires the labour of men at a capstan to remove it from the opening, or to close that opening again. The caisson of 1798 required nothing more than a common guy-rope to remove and guide it.

As to the comparative cost of the Keyham caisson, there are no available data on which to ground any such calculation. The strength of the caisson at Keyham appears to have been due to Mr. Fairbairn's great experience and skill in works composed of iron. Possibly, a lesser amount of strength might have sufficed, and thereby some expense might have been saved; but it is not customary in dockyards to spare first cost, the value of the interest on money never being brought to account.

It seems unfortunate for Mr. Scamp's reputation that many inventions have been ascribed to him that are really due to others. Thus, a rectangular form for a caisson was given long ago to me for Sheerness Dockyard, by Mr. Mitchell, the engineer of that establishment; but, in that instance, it was because the materials to be employed were deals, and, consequently, straight. Mr. Scamp is thought to have been the first to avoid the laborious business of pumping a caisson; whereas Mr. Fincham, many years master-shipwright of Portsmouth Dockyard, after having served the same distinguished office in other Royal yards, assured me that this duty was never requisite in Sir Samuel Bentham's caissons; and that, as to valves, he had never known a caisson without them, though this invention he also attributed to Mr. Scamp. But it has been the lot of many of Sir Samuel Bentham's inventions to be claimed by others; as, for example, that great comfort to seamen, the keeping water sweet at sea in metallic tanks, and the much-employed steam dredging-machine with buckets on a chain.

I am, Sir, &c. &c.,

20th April, 1855. M. S. BENTHAM.

ON SCREW STEAM-COLLIERS.

To the Editor of THE ARTIZAN.

SIR,—In the report of this paper which was recently read at the Institution of Civil Engineers, many valuable points are stated therein, but not fully developed, evidently for want of practical experience in working the London coal-trade; and, as one engaged in unloading coals by steam-power in the port of London, I am disposed to make a few remarks upon matters such as occur to me as being imperfectly known, and, I believe, not brought forward in Mr. Allen's paper: and, with your permission, I will, in the first place, deal generally with the whole subject of screw-colliers, and afterwards refer to the points I have mentioned as more particularly requiring comment.

I contend, that whilst screw-colliers, to be commercially economical as compared with the sailing-vessels ordinarily employed, must be of larger tonnage than heretofore considered advisable, yet the great length of such vessels, if built according to existing notions of proportion, would render it difficult to manage them in such a navigation as the Thames: moreover, there are other reasons, as appertaining to the filling or stowing and trimming of such cargoes as these vessels would carry, as well as the unloading or discharging of such cargoes, which must be considered in determining the size, form, and mode of propulsion best suited to this trade.

Let us admit that iron, as a material for building screw-colliers, is the best suited for such a purpose; for I think *that* point will not now-a-days be contested.

Long, narrow iron vessels must, to be strong, be constructed with bulkheads and cross-bracings, so that the cargo is divided. Now, dividing a cargo of coals is practically found a great disadvantage, more especially in working them out, as there is great loss of time in breaking bulk, or breaking down in *each hold* or division of the ship.

Vessels built of a breadth proportionate to their length, for carrying very large cargoes of coal, would be difficult to work in connexion with existing Dock arrangements on the Thames, whether it be with reference to the breadth of entrance-locks, the berth-room, or the hoisting appliances in use; but I am quite convinced that the principle can be demonstrated that larger vessels must be employed, and that the increase must be carried to the extent of a capacity of available cargo-space of from 2,000 to 3,000 tons, so as to fully carry out in an economical point of view the commercial advantages of steam-propelled colliers, as well as the improved means recently introduced for unloading cargoes of coal.

If vessels of the above tonnage are built with suitable steam-power and form of propeller, and increased facilities are given for loading such vessels at the coal shipping ports, as also for unloading them without delay, the supply in the London market would be more regular, the prices generally lower and more uniform—advantages alike to the shipper, merchant, and consumer.

I am, Sir, &c.,
ONE WHO HOISTS BY STEAM POWER.

[We are compelled, from want of space, this month, to omit the most important portion of this letter.—ED.]

MUNTZ'S PATENT METAL.

(To the Editor of the "Mining Journal.")

SIR,—Your correspondent, writing under the assumed title of "Fair Play,"* flatters himself that, because I have not entered more fully into the chemical properties of yellow metal, I am unable to bring forward any argument to refute the assertions of some individuals (who, had they been better informed, would not have made them), but he will be disappointed.

That a galvanic action takes place between copper and zinc, every child from school knows, or should know. Your correspondent should bear in mind that pure metals are not alloys; and that alloys of the same metals, but of different proportions, have different properties, and are suitable for different purposes. The specification of Muntz's patent metal, for which the patent was granted in 1832, comprises several proportions of copper and zinc, mixed into alloys which will roll hot, or, in other words, are malleable when at a red heat: these proportions range from 50 parts of pure copper and 50 parts of pure zinc, and 63 parts of pure copper and 37 parts of pure zinc, with all the intermediate proportions. When the alloy contains a smaller proportion of copper than 60 parts, it is open in its texture, presenting a granular appearance, something similar to pure zinc, but finer in its crystallisation, according to the quantity of copper it contains. In such proportions, the zinc in the alloy is acted upon by salt water more than the copper—it penetrates into the substance of the metal, removing a great portion of the zinc, and leaving the metal in a porous and brittle state: on the other hand, when a larger proportion of copper is used, the alloy assumes a contrary appearance, being remarkably close in texture, more so even than pure copper; the action on the zinc, which occurs in the common alloy, does not take place; and when exposed to corrosion, the whole of the compound is destroyed (the original ductility of the metal being retained to the last), in the same manner that pure copper would be, except that the corrosive action is slower.

* *Ante*, page 91.

In the manufacture of sheathing, all that a shipowner requires is that it shall retain sufficient ductility to remain on the ship; and that it shall contain sufficient copper that the portion of its oxide shall prevent the vessel from becoming foul. Keeping those two points in view, the more zinc the sheathing contains the better, so that the oxidation may be reduced to the smallest possible extent compatible with keeping the vessel clean, thereby rendering the metal more durable, and insuring a larger weight returned when stripped off the ship. With bolts and fastenings the case is widely different: the shipowner must not only have a durable metal, but he must have one which will retain all its ductility and strength to the last. Here, then, a larger proportion of copper in the alloy is indispensable; it gives to the shipowner a material 50 per cent. stronger than pure copper, and considerably more durable. I will not say a cheaper one, for cheapness should not be taken into account, when the importance of a ship's fastenings are considered. In confirmation of what I have stated, I enclose a piece of sheathing which has been at sea some time, containing rather more copper than is usually mixed in yellow metal required for that purpose. You will observe that it is reduced to nearly the thinness of paper, without the ductility being the least impaired; the original thickness having been that of the part which has been covered by another sheet.

These remarks apply to metal which is used in boiler-tubes, for the strain to which they are exposed by contraction and expansion renders it necessary to employ a material which will retain its ductility. Your correspondent calls on me to name the manufacturers of spurious metal, in order that they may vindicate themselves. I should imagine that spurious manufacturers would prefer that their names should remain unknown. In my opinion, all who make bad metal are spurious manufacturers. But, before your correspondent asks for names, let him tell us his own. Does he think to hide from the public that he is an interested party by hiding his name? Dare he come forward and declare he is not a manufacturer of brass tubes? Let your readers judge if his last remark is not a confirmation of my former letter. Your correspondent also contradicts himself, and proves thereby that his statement with regard to the value of old yellow metal is not true: he admits that 10½d. per lb. is paid for old metal; thus, he feels convinced that if Mr. Muntz and the spurious manufacturers did not give this established price—viz., "10½d. per lb., or 1½d. under new," &c.; and then he goes on immediately to say, that "every shipholder knows he can scarcely dispose of old metal at half its value." Does not this show that such old metal, which the shipowner cannot dispose of, is not genuine, and is unfit for re-manufacture? Surely it is not important to shipowners whom they sell to; and one would imagine that they would prefer to dispose of their old metal at 10½d., rather than send it to the Birmingham market at half its value.

It may, perhaps, not have come under your notice that yellow metal has now been used for many years by some of our most celebrated marine engineers, not only for pins and bolts exposed to sea-water where copper was formerly used, but for air-pump rods of engines. How is it that those have not failed, when the strain and working of the machinery would have detected any deterioration in the quality of the material? I am not, Mr. Editor, in the habit of noticing anonymous letters, which is something like fighting with shadows; and I should not have done so now, had not the circumstances of the case required an explanation from me. If your correspondent will attach his real name, his communications will have more the appearance of "Fair Play," and I shall then be happy to keep the subject of yellow metal before your readers as long as it is agreeable to your correspondent, and you are kind enough to give my letters space in your Journal.

G. F. MUNTZ, Jun.

Birmingham, March 14.

ROYAL SCOTTISH SOCIETY OF ARTS.

The Royal Scottish Society of Arts met on Monday, 26th March, 1855, at eight o'clock P.M.,—DAVID RHIND, Esq., President, in the chair,—when the following communications were made:—

1. *On the Theory of the Driving Belt, Part II.* By EDWARD SANG, Esq., F.R.S.E., V.P.—Thanks voted.

2. *Description of Drawing of an Apparatus for Drawing in correct Perspective any Object or Landscape.* By Rev. WILLIAM TAYLOR, Hon. F.R.S.S.A., 73, Oxford-terrace, Hyde-park, London.—This apparatus consists of a wooden box, fifteen by twelve inches, and one inch deep. The lid is made, when open, to stand at right angles, and fixed there. On the opposite side of the box a slip of wood is fixed, having a hole at the top, through which the eye looks at the object to be copied. Opposite to this parallel tubes are fixed upon the open lid of the box, operating as a photograph; at the upper end of the parallel tubes is a hole through which the eye sees the object to be copied, and this orifice is made to travel along the outline of the object. The other end of

the parallel tubes has a pencil fixed in it, which is pressed by a spring to a piece of paper fastened to the inside of the lid by button pins, and which accordingly traces the outline of the object, being the counterpart of the object itself traced by the other end of the parallel tubes. By means of this instrument, the Author stated that any object or landscape can be more correctly copied than by the *camera lucida* or any other instrument known to him, that a few trials will be found sufficient to enable a person to use the instrument, and that it has the advantage of being portable, easily made, not difficult to use, and not expensive.—Referred to a committee.

3. *Description and Drawings of some New Platometers.* By Mr. P. M'Farlane, Comrie.

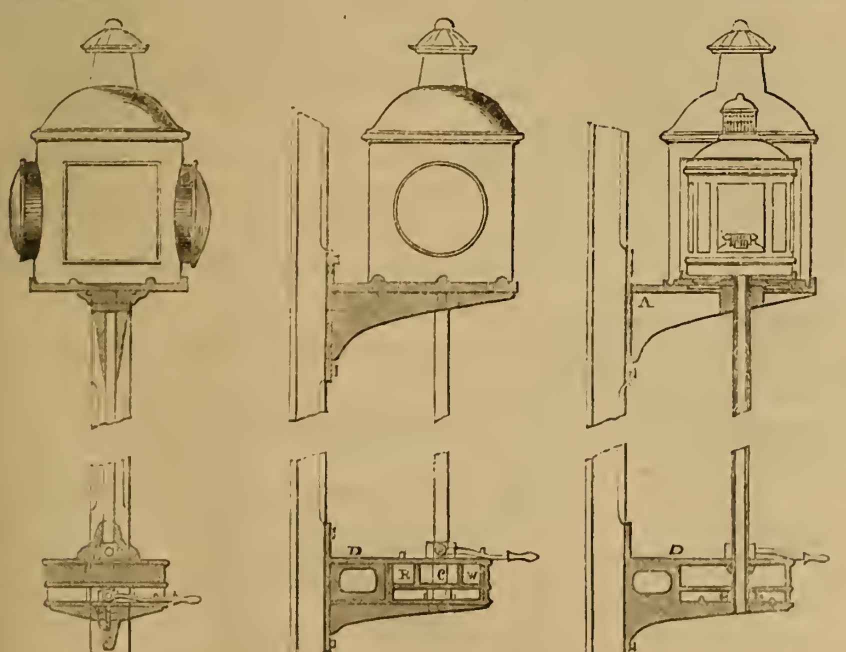
4. *Report of Committee on Mr. George Johnstone's Improvement on the Thrashing Mill.* Mr. Bertram, convener.—Read and approved.

The following donation was laid on the table, viz. :—A four-inch Electro-Magnet, said to have sustained 1,500 lbs. weight, made many years ago for the purpose of ascertaining what number of coils would produce the greatest effect with reference to the weight of iron required for these coils; in the course of which experiments it was found that the best relative effect was produced with four coils, and that an *even* was better than an *odd* number of coils. Presented by the inventor, Richard Roberts, Esq., engineer, Globe Works, Manchester, Hon. F.R.S.S.A.—Thanks voted to the donor.

NOTES AND NOVELTIES.

Saxby's Economic Safety Lamp.—This signal apparatus merits the advantages claimed for it; and where one signal can be placed at a station to show sufficiently far on the up and down lines, its advantages, as compared with the present system of two lamps with their posts and fittings, must be apparent. A fixed lantern, with two lenses at opposite sides so arranged as to show both up and down from a station, is mounted upon a bracket projecting from the signal-post. Within the lantern are two circular frames, revolving closely within each other: each frame is glazed with a sheet of white, green, and red glass. These inner frames revolve separately, one being worked by a tube affixed thereto, which passes down to the bracket at the bottom of the post. Inside of this tube is a rod or tube of smaller diameter, which is connected with the inner coloured glass frame, but is longer than the outer tubes, and takes its bearing on the lower part of the bottom bearer or bracket, which is bolted to the foot of the signal-post. To the lower end of the tube is attached a handle, by which the outer glazed frame is turned; and either a green, red, or white coloured glass is brought between the lamp or burner, and the bull's eye or lens on the side of the lantern corresponding with the handle so turned. To the inner rod or tube a similar handle is attached, which works the inner coloured glass frame in a manner similar to that just described.

The arrangements for working the up and down signals in the same lantern with one lamp will be better understood, after what has been described, by reference to the diagrams, where it will be seen that D, the bottom bracket, is so arranged as to give a bearing to the larger tube on the upper division of the bracket, and to the internal rod or tube on the lower division of the bracket. The one side of each division of the bracket is painted in the colours to correspond with the colours in the glazed frames; so that when the signal-man places the right-hand handle upon one of the steady pins projecting from each of the three coloured divisions, the lantern will show the corresponding colour up the right-hand line. The left-hand handle being similarly worked, will cause the lantern to exhibit the desired colour down the left-hand line.



This invention is highly spoken of by the Engineer of the London, Brighton, and South Coast Railway, who has adopted it upon the lines under their management.

The Patent Compensation Gas Regulator.—We have recently witnessed some experiments with an improved gas-regulator, which, for simplicity of arrangement, is unequalled. The principle of construction is simple and ingenious, and when the parts are properly proportioned, the result cannot fail to be satisfactory.

There are no levers, hinges, or knuckle-joints, to become deranged and inoperative from the impurities of the gas, from straining, or other causes. On reference to the diagrams (of which Fig. 1 is an outside view, and Fig. 2 a sectional elevation), it will be seen that the apparatus

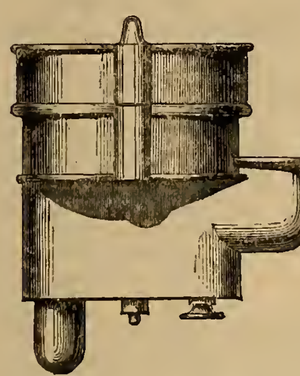


Fig. 1.

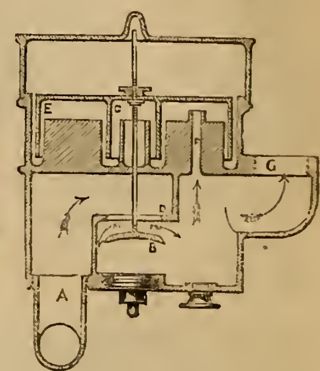


Fig. 2.

consists of a cored iron casting, over which is fitted a cover: the lower chamber has an inlet opening, A, through which the gas passes from the main in the direction of the arrow; the chamber is divided transversely, as shown in section, Fig. 2, there being a circular opening or valve-seating, D, in such division; the valve, B, closing the opening, D, when raised sufficiently high for that purpose; but, in practice, when the regulator is adjusted for a given pressure, this valve only partially closes the opening, to reduce the supply of gas in proportion to the consumption. After the gas has passed from the inlet side of the valve into the second division of the lower chamber, it may pass through the outlet, G, into the service-pipes and fittings, to be consumed; but if the pressure be suddenly increased at the main, or a number of the burners on the consumption-side of the meter be turned out, and the pressure of the gas in the service-pipes is thereby increased, the valve B is raised in a degree corresponding to the reduced consumption; and this operation is effected, self-acting, in the following manner:—The upper half of the main casting has two annular spaces or grooves cast therein, and the centre-piece is cored through to allow of the spindle of valve B, as also the gas, passing through it easily: the annular grooves are filled with mercury, and a double cylinder or close cover, C, made to work freely in the two annular grooves, is attached to the upper screwed end of the spindle of the valve B, upon which it is adjusted by means of a screwed nut. This cover forms two chambers; the one, C, the compensating cylinder—the other, E, the regulating cylinder: the area of the former corresponds to the area of the valve B. From the outlet side of the lower part of chamber, a small opening, F, is made through the partition-wall, between the annular grooves, through which the gas passes into the annular space or regulating cylinder, E: the gas also passes into the compensating cylinder, C, from the first division of the lower part of chamber, through the opening for valve-spindle, pressing it upward with a pressure due to the force of gas at the main. The cylinders C and E, being floated in the mercury contained in the annular spaces, the gas cannot escape.

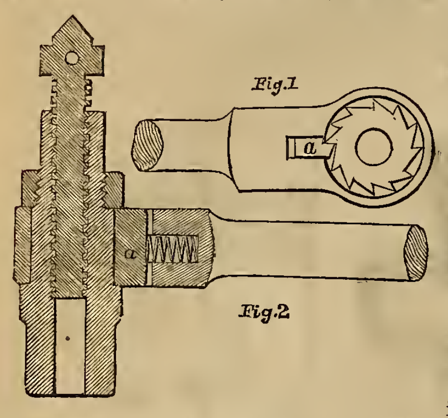
When the pressure upon the cylinder C increases, as compared with the pressure upon the cylinder E, the cover or cylinders rise out of the mercury, and so close the valve B to an extent sufficient to admit of a proportionately smaller amount of gas passing through the regulator to the burners; but when the pressure is reduced at the main, the cylinders fall, become deeper immersed in the mercury, and the passage through the valve-seating, D, becomes larger, admitting an increased quantity of gas to maintain the proper supply and pressure at the burners.

The surface of the mercury is covered with oil to prevent oxidation; and the working parts of the apparatus are enclosed by a cover, which can readily be removed for the examination or adjustment of the cylinders and valve.

They are found to act remarkably well, and, when properly fixed, are not liable to derangement.

The saving in the consumption of gas effected by their use must be considerable, especially where there is a constantly-varying pressure at the main.

FENN'S PATENT RATCHET BRACE.—Mr. Fenn, of Newgate-street, has recently produced a simple and very useful instrument for drilling, which he has secured by patent. Those who have used the common ratchet-brace know how liable it is to become deranged, the exposure of the spring and ratchet being the main cause. In Mr. Fenn's ratchet-brace, the ratchet-wheel is enclosed in the eye or boss of the lever, and the pall with its spring is similarly protected. On reference to Figs. 1 and 2, the construction will be readily understood. The spiral spring, A, acting at the back of the pall, forces it into a tooth of the ratchet-wheel, whilst it permits of the lever being worked with great ease; and as the pall is supported throughout its length in the slot in which it is fitted, it is not liable to become strained. This brace is therefore well adapted for heavy work, and the rough usage to which such tools are subjected.



BOWER'S PATENT PILE-DRIVER.—The novelty consists in the mode of working pile-engines by a continuous circular motion of the winch-handle, instead of, as ordinarily worked, at short intervals only, and then overhauling the tackle. Mr. Bower constructs the pile-engine frame much in the usual manner, but applies an endless chain or rope, which passing over a sheave at the top and the bottom of the pile-engine, has one turn wound round the barrel of a crab or windlass, to which motion is communicated in the usual manner. The ram is fitted with a pair of spring-jaws, against which the stops or catches projecting from the chain at certain intervals come in contact, and carry upward the ram as the chain is caused to ascend; and when the ram has reached the point at which it is desired to detach it, a suitable wedge-like trigger, which is adjustable at pleasure, opposes the further progress of the ram, opens the jaws, releases the ram from the stop or catch upon the chain: thus freed, the ram falls.

The spring-jaws of the ram close immediately it is disengaged from the chain, in readiness for the succeeding stop or catch, which, in course of working the winch, will come in contact with the under side of the spring-jaw; and so in like manner the ram is again raised. This machine will be found very useful, whether worked by hand-power or by steam.

IRON.—That valuable but indifferently appreciated metal, so much maligned as a material for building ships-of-war, has recently been pressed into that branch of the Naval Service, in a manner well suited to exhibit its usefulness as a shot-resisting material, and for the defence of Naval armaments, and where for the first time it will be comparable with its opponent material, stone. Applied as it has been in the instances to which we allude, viz., in the floating batteries, we have no fear as to the result of the trial Iron *v.* Stone.

AS SIGNS OF THE TIMES—The appointment of I. K. Brunel, Esq., C.E., as Consulting Engineer to the War Office—the employment of civil engineers and officers of the Board of Health in superintending sanitary matters at the seat of war in the East—the substitution of civil engineers and surveyors for the military engineers hitherto employed by the Hon. East India Company on public works in India—and many other instances of a similar nature, go to show that a more just appreciation and more extensive application of the engineering talent of this country is being usefully made in many branches of the public service.

LOWERING SHIPS' BOATS.—At a late meeting of the Institution of Civil Engineers, there was exhibited in the library a model of a system, introduced by Mr. Clifford, for lowering ships' boats from the davits, evenly, quietly, and safely, in a gale of wind, and disengaging them without any risk of capsizing, or being dragged under by the speed of the vessel.

The chief point was the employment of a block of a novel form, having three sheaves placed over each other, through and between which the lowering ropes passed in such a manner as to have a tight grip upon them, and yet so that, by letting all run free, the falls would run out in such a manner as to let the boat down on the water on an even keel, and quite free from the ship. The lowering could be accomplished by a man sitting in the boat; and though with a full loading, the descent could be checked at any point. It was evident that by this system the disastrous effects of undue haste in rushing to the boats, in cases of danger, would be completely obviated.

A simple, ingenious system of a hollow rotating boat-plug for the bottom of the boat was also shown.

NOTICES TO CORRESPONDENTS.

W. E. G. (Totnes).—We intend shortly to give some examples of pumping-engines, and the most recent improvements in mining machinery. The plates are in progress.

H. B. S.—There are many very ingenious contrivances for producing the material the subject of your inquiry. Agricultural engineering has received a share of attention from us, and will continue to do so. When anything worthy of note occurs, it finds its way into our pages.

A. H. S.—Your request to be informed as to oakum-picking by machinery shall be attended to. We will ascertain the best construction, and by whom made; and we shall be obliged to any of our readers who will inform us upon this subject.

C. D.—No. Wire-drawing machinery has never been described in our pages; but if you will inform us what you wish to know, we will endeavour to supply the information.

SCREW COLLIERS.—The remainder of your letter will appear next month.

Q.—The rope-making machinery referred to is novel and very simple. There are many points which require consideration in connexion with the manufacture your letter treats of. Perhaps by next month we may give you the required information in our pages. The subject certainly has interest.

DIMENSIONS OF STEAMERS.

CLYDE AND CALCUTTA MONTHLY LINE OF PACKETS: "CITY OF BENARES."

Built by Messrs. Robert Barclay and Curle, shipbuilders, Finnieston, Glasgow, 1853.

Dimensions—Builders' measurement.	ft.	in.
Length of keel and fore-rake ...	163	2
Breadth of beam	30	1
	Tons.	
Register	$720\frac{16}{94}$	
Customs' measurement.	ft.	tenths.
Length on deck	163	8
Breadth at two-fifths of midship depth	27	4
Depth of hold amidships	20	9
	Tons.	
Tonnage, Sectional Act	$750\frac{87}{100}$	
Ditto, Act for Foreign Vessels ...	$721\frac{71}{130}$	

Classed 13 years A 1 at Lloyd's; carries 1,251 tons dead weight of cargo. Launched March 10th.

DESCRIPTION.

A full female figure-head; no galleries; standing bowsprit; three masts; ship-rigged, square-sterned, and carvil-built vessel of timber; flush on deck. Owners, George Smith and Sons. Port of Glasgow.

CLYDE AND CALCUTTA MONTHLY LINE OF PACKETS: THE "CITY OF MANCHESTER."

Built by Messrs. Robert Steele and Co., shipbuilders, Greenock, 1854.

Builders' measurement.	ft.	in.
Length of keel and fore-rake ...	163	8
Breadth of beam	30	$0\frac{1}{2}$
	Tons.	
Register	$721\frac{41}{94}$	
Customs' measurement.	ft.	tenths.
Length on deck	165	3
Breadth at two-fifths of midship depth	27	1
Depth of hold amidships	21	1
	Tons.	
Register, Sectional Act	$766\frac{37}{100}$	
Ditto, Act for foreign vessels ...	$711\frac{99}{130}$	

Classed 13 years A 1 at Lloyd's, the difference in tonnage being in favour of the Act for foreign vessels; had on board the first voyage, 1,500 tons of cargo for Calcutta. Launched May 29th.

DESCRIPTION.

A full female figure-head; no galleries; square-sterned and carvil-built vessel of timber; standing bowsprit; flush on deck. Owners, Messrs. George Smith and Sons. Port of Glasgow. Commander, Mr. Francis Cowan.

CLYDE AND CANADA LINE OF PACKETS: THE "CHEROKEE."

Built by Messrs. Robert Steele and Co., shipbuilders, Greenock, 1854.

Builders' measurement	ft.	in.
Length of keel and fore-rake ...	163	8
Breadth of beam	30	$0\frac{1}{2}$
	Tons.	
Register	$721\frac{41}{94}$	
Customs' measurement.	ft.	tenths.
Length on deck	164	2
Breadth at two-fifths of midship depth	27	5
Depth of hold amidships	19	8
	Tons.	
Register, Sectional Act	$718\frac{96}{100}$	
Ditto, Act for foreign vessels ...	$690\frac{102}{130}$	

Classed 9 years A 1 at Lloyd's; was launched on the 14th of June. Owners, James and Alexander Allan.

DESCRIPTION.

A bust man figure-head: no galleries; square-sterned and carvil-built vessel of timber; standing bowsprit; flush on deck; three masts; ship-rigged.

Port of Glasgow. Commander, Mr. William Allan.

CLYDE AND CALCUTTA MONTHLY LINE OF PACKETS: THE NEW IRON CLIPPER SAILING-SHIP "CITY OF MADRAS."

Built by Messrs. Robert Steele and Co., iron shipbuilders, Greenock, 1855.

Builders' measurement	ft.	in.
Length of keel and fore-rake ...	190	0
Breadth of beam	30	0
	Tons.	
Register tonnage	$823\frac{33}{94}$	
Customs' measurement	ft.	tenths.
Length on deck	194	8
Breadth at two-fifths of midship depth	29	2
Depth of hold amidships	20	8
	Tons.	
Register, Sectional Act	$914\frac{32}{100}$	
Ditto, Act for foreign vessels ...	$914\frac{117}{130}$	

Classed 12 years A 1 at Lloyd's; is a very strong and handsome-looking craft, and the first iron vessel on this line of packets, and the second built by the above firm. Was launched on 19th February: draft of water at launching, forward, 7 feet 5 inches; aft, 8 feet 10 inches.

DESCRIPTION.

A full female figure-head; square-sterned and clinch-built vessel of iron; standing bowsprit; clipper bow; flush on deck. Owners, Messrs. George Smith and Sons.

Port of Glasgow. Commander, Mr. James Stobo.

DIMENSIONS, ETC. OF STEAMER "ARIEL."

Built by J. Simonson, New York; engines by Allaire Works, New York.

Length on deck	250 ft.
Breadth of beam	33 ft. 6
Depth of hold at do.... ...	19 ft.
Do. do. spar deck ...	26 ft.
Tonnage	1,300 tons.

Kind of engine, vertical beam. Kind of boilers, return-flued. Diameter of cylinder, 75 inches; length of stroke, 11 feet; diameter of wheel over blades, 33 feet; length of blades, 8 feet; depth of blades, 1 foot 6 inches; number of blades, 28; number of boilers, 2; length of boilers, 32 feet; breadth of boilers, 12 feet 6 inches; diameter of shell of boilers, 11 feet 2 inches; height of boilers, exclusive of steam-chimney, 11 feet 8 inches; number of furnaces, 3 in each boiler; length of fire-bars, 7 feet 6 inches; number of upper flues, 6; internal diameter of upper flues, 1 foot $5\frac{1}{4}$ inches; length of ditto, 24 feet; diameter of chimney, 74 inches; height of ditto, 48 feet; area of immersed section at load-line, 440 square feet; contents of bunkers in tons, 600; draft forward, 14 feet; draft aft, 19 feet; masts, two; rig, fore-top-sail schooner. Intended service, New York to Liverpool.

REMARKS.

Construction, natural draft; hull strapped with diagonal and double-laid iron braces; planks, edge-bolted.

Floors, moulded, 16 inches; sided, 12 inches; and 24 inches apart at centres.

DIMENSIONS OF STEAMER "OCEAN BIRD."

Built by J. W. Griffiths, New York; engines by Neptune Iron Works, New York.

Length on deck...	225 ft.
Breadth of beam (moulded) ...	37 ft.
Depth of hold	16 ft.
Ditto to spar-deck ...	23 ft. 4 in.

Kind of engines, vertical beam. Kind of boilers, upper return-flued. Diameter of cylinder, 65 inches; length of stroke, 12 feet; diameter of paddle-wheel over boards, 32 feet 9 inches; length of boards, 7 feet 9 inches; depth of boards, 1 foot 10 inches; number of boards, 28; number of boilers, 4; length of boilers, 20 to 22 feet; breadth of boilers, 9 feet 6 inches; height of boilers, exclusive of steam-chests, 10 feet 2 inches; number of furnaces, two in each; breadth of furnaces, 4 feet $2\frac{1}{2}$ inches; length of fire-bars, 6 feet 6 inches; number of flues, below 10, above 5; internal diameter of lower flues, 13 and $19\frac{1}{2}$ inches; internal diameter of upper flues, $17\frac{1}{2}$ inches; diameter of chimneys, 3 feet 7 inches; height of chimneys, 50 feet; load on safety-valve in lbs. per square inch, 20; area of immersed section, 252 square feet; draft forward (loaded), 8 feet 3 inches; draft aft, 8 feet 4 inches; masts, two; rig, brigantine.

LIST OF PATENTS.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 18th December, 1854.

2661. W. Gilpin, 2, Moorgate-street, and A. Bowen, Stafford-street, Peckham—Prevention of smoke.

Dated 17th January, 1855.

126. J. Slack, Manchester—Woven fabrics.

Dated 16th February, 1855.

351. R. A. Brooman, 166, Fleet-street—Preparing certain fibres for manufacturing purposes. (A communication.)

Dated 17th February, 1855.

358. H. P. Haughton, Bethnal-green—Wearing apparel for the ankles.

Dated 20th February, 1855.

374. F. B. E. Beaumont, Upper Woodball, Barnsley, Yorkshire—Revolvers.

Dated 28th February, 1855.

432. T. Helliwell and J. Barker, Todmorden—Preserving pickers and picker-sticks, and preventing cops being knocked off in weaving.

Dated 1st March, 1855.

451. J. Ramsbottom, Accrington, Lancashire—Steam-engines and motive power.

Dated 5th March, 1855.

482. J. Gledhill, Congleton, Cheshire, and R. Gledhill, Halifax—Preparation of silk, flax, and other fibrous substances, and in the machinery employed therein.
484. W. Johnson, 47, Lincoln's-inn-fields, and Glasgow—Coating iron and steel wire with other metals or alloys. (A communication.)
486. A. Hotchkiss, New York, U.S.—Projectiles.
488. Arsène Louis Garnier, Gurnsey—Photography, denominated "Système Garnier de Photocherographie coloriée."
490. R. Van Valkenburgh de Guinon, Brooklyn, State of New York, U.S.—Anchors.
492. J. Wood, 30, Barbican—Ornamenting woven fabrics for bookbinders and others.

Dated 6th March, 1855.

494. W. Hyde, Spring-hill, Ohio, U.S., and 17, Cornhill—Marine life-preserving apparatus.
498. J. Player and L. D. Jackson, 2, Winchester-buildings—Furnaces for the prevention of smoke.
500. T. Lawson and M. Thompson, Gateshead-on-Tyne—Consumption or prevention of smoke.

Dated 7th March, 1855.

502. J. Kennedy, Liverpool—Manufacture of boots and shoes.
503. J. Higgins and T. S. Whitworth, Salford—Small arms, hardening articles of metal.
504. J. Cooper, Birmingham—Joiners' braces and bits.
505. W. Weild, Manchester—Looms for weaving pile-fabrics.
507. J. W. Sloughgrove and J. H. Wheatly, Windsor-street, Islington—Smoke-consuming furnaces.
508. J. M. Napier, York-road, Lambeth—Machinery for manufacturing balls for small arms.
510. J. Wilson, Hurlet, county of Renfrew, and J. Horsley, Cheltenham—Manufacture of iodine and iodides, and of a pigment or pigments therefrom.

Dated 8th March, 1855.

511. B. L. F. X. Flechelle, Paris—Porte-monnaies.
512. L. E. Bataille, of Paris—Looms for weaving pile-fabrics.
513. G. C. Reitheimer, Holyhead, Anglesea—Means of loading or discharging fire-arms.
514. T. Walker, Birmingham—Rotary engines by steam or other fluid.
515. A. F. J. Claudet, Regent-street, Westminster—Stereoscopes.
516. G. Hazeldine, Lant-street, Southwark—Wheel-carriages and wheels.
517. A. Krupp, Essen, Prussia—Construction of railway wheels.
518. J. Brooks, Bury, Lancashire, and Walter William Stephen—Looms for weaving.
519. J. Taylor, Spring-grove, Isleworth—Packing and preserving eggs and other articles of food.
520. H. Gilbert, Kensington—Hurdles.
521. J. and S. Aitken, and J. Haslam, Bacup, Lancashire—Machines for preparing, spinning, and doubling cotton, wool, flax, silk, &c.
522. J. Norton, Dublin—Fire-arms and ammunition.
523. W. Foster, Black Dike Mills, Bradford—Machinery for drying wool, &c.
524. W. Foster, Black Dike Mills, Bradford—Machinery or apparatus for cleansing wool, &c.
525. J. Bernard, Club-chambers, Regent-street—Manufacture of boots and shoes, and machinery for same.
526. J. Gerard, Guernsey—Portable floating-pier, &c.

Dated 9th March, 1855.

527. G. White, 5, Laurence Pountney-lane, Cannon-street—Treatment of horn, &c. (A communication.)
528. P. Dall, Woolwich—Self-acting indicating and recording mechanism for steam-engines.
529. J. Bullough, Accrington—Looms and apparatus for weaving.
530. J. Murdoch, 7, Staple-inn, Holborn—Shade or reflector for lamps. (A communication.)
531. J. Murdoch, 7, Staple-inn, Holborn—Method of enlarging or reducing designs, maps, &c., and machinery for same. (A communication.)
532. F. A. Barnet, Nelson-street, Bristol—Manufacture of metallic bedsteads and couches for the use of invalids, &c.
533. T. Hill, the Birches, Stanton Lacey, Shropshire—Machinery for the manufacture of bricks, drain-pipes, tiles, &c.
534. S. Lister, Manningham, Bradford—Treating and preparing the fibres of flax, hemp, &c., for spinning.
535. G. Bousfield, Sussex-place, Loughborough-road, Brixton—Preparing wool, &c., for spinning. (A communication.)
536. S. C. Lister, Manningham, Bradford—Combing the noil of silk waste.
538. S. C. Lister, Manningham, Bradford—Machinery for combing wool and other fibres.

Dated 10th March, 1855.

540. W. Mickle, Willington, Durham—Smelting or production of iron from its ore in blast furnaces.
541. A. Clark, Gate-street, Lincoln's-inn-fields—Globes.
542. J. Sunderland, Marsden, near Burnley—Self-acting apparatus for regulating the flow of liquids from casks.
543. J. Hughes, Newport, Monmouthshire—Bushing touch-holes of cannon.
544. C. Heaven, Hull—Machinery for embroidering fabrics.
545. A. E. L. Bellford, 32, Essex-street, Strand—Machinery for making butt-engines at one operation. (A communication.)
546. R. Brisco, Low Mill House, St. Bees, Cumberland, and S. Horseman, St. John's Beckermet—Preparation of flax.

Dated 12th March, 1855.

547. J. Malcomson and R. Shaw, Portlaw, and W. Horn, Mark-lane—Expansion valves.
548. D. H. Brandon, 11, Beaufort-buildings, Strand—Machinery for cutting fustians, &c. (A communication.)
549. J. Brookes, Birmingham—Waistcoat.
550. J. Hulls, Plaistow, Essex, and J. Lowe, Lambeth-road—Coating iron and other metals with lead.
551. G. Mosley, Southwark—Buttons.
552. J. Gilbert, Engine-works, Boston-street, Hackney—Pump or pumping apparatus.
553. W. P. Stanley, Peterborough—Clod-crushers.
554. W. Scoro, Bristol—Bleaching oils, fats, and resin.
555. J. M. Napier, York-road—Furnaces used in the manufacture of soda or alkali.

Dated 13th March, 1855.

556. D. Macaire, Paris—Casks and taps.
559. T. W. Willett, 25, Belsize-road, St. John's-wood—Swimming-belts.
560. S. Swingle, Aston-juxta-Birmingham—Metallic spoons, forks, and ladles.
561. J. Gracie, Stanley-terrace, Rotherhithe—Wood-planing machines.
562. A. V. Newton, 66, Chancery-lane—Engine to be actuated by the expansive force of explosive mixtures. (A communication.)
563. C. Iliffe, Birmingham—Manufacture of metallic rods, bars, and tubes.

Dated 14th March, 1855.

564. R. C. G. Cooke, New Swindon—Cloaks.
565. G. Riley, 12, Portland-place-north, Clapham-road—Starch or grape sugar.
566. H. Gray, 60, Clement's-lane, Strand—Substitute for flock.
567. B. Goodfellow, Hyde—Regulating the power for driving pumps of hydraulic presses.
568. R. Neale, Cincinnati, U.S.—Copper-plate printing.
569. J. Kidder, Plaistow—Castors.
570. W. and J. Galloway, Manchester—Regulating the pressure on slide-valves of steam-engines.
571. J. Marland, Walsden—Rollers for spinning and other machinery.
573. W. Soelman, 3, Bennett-street, Fitzroy-square—Propellers.
574. E. J. Mitchell, Bradford—Rollers in washing wool and linen.
575. J. Turner, Farringdon-street—Coffin furniture.
576. J. Bernard, Club-chambers, Regent-street—Boots and shoes.
577. C. Goodyear, jun., Paris—Plates of artificial teeth.
578. R. Wright, Richmond, York—Swords.
579. A. Davis, Tottenham-court-road—Polishing powder.
580. J. Hetherington, Manchester, and A. Vickers, Bristol—Spinning machinery.
581. W. Lister, Richmond, Yorkshire—Implement for raising roots in the ground, &c.

Dated 15th March, 1855.

582. H. Bach, Sheffield—Sash-frames.
584. R. M. Butt, Fairfield-works, Bow—Night-lights.
585. E. Humphrys, Deptford—Applying heat to steam-boilers.
586. F. Loret-Vermeersch, Malines—Stopping trains on railroads.
687. W. Monday, jun., Kingston-upon-Hull—Preparing plumbago, graphite, &c., for polishing and lubricating, &c.
588. G. Grignon, 13, Sutherland-square, Walworth—Detaching boats from ships' sides.
580. H. Wickens, 4, Tokenhouse-yard—Communicating signals in railway-trains.

Dated 16th March, 1855.

590. J. Mitchell, Sheffield—Supplying grease to engines.
591. W. Hill, Birmingham—Metallic pens and penholders.
592. M. Smith, Heywood—Looms.
593. J. W. C. Wren, Tottenham-court-road—Invalid bed.
594. T. Picton, Liverpool—Scaffoldings.
595. W. Winstanley and J. Kelly, Liverpool—Force-pumps.
596. A. Mauduit and F. H. Ouin, Paris—Hydraulic machine.
597. Sir W. Burnett, Somerset-house, and J. W. D. Brown, R.N., Haslar Hospital, Gosport—Constructing signal-lanterns.

Dated 17th March, 1855.

598. T. Petitjean and — Pitre, 45, Upper John-street, Tottenham-court-road—Daguerreotype plates. (A communication.)
599. E. Breittmayer, Paris—Mortising machine.
600. J. H. Johnson, 47, Lincoln's-inn-fields—Application of carbonic acid gas as a motive-power. (A communication.)
601. J. H. Johnson, 47, Lincoln's-inn-fields—Steam-engines. (A communication.)
602. J. H. Johnson, 47, Lincoln's-inn-fields—Steam-pressure and other indicators. (A communication.)
603. T. G. Shaw, Old Broad-street—Facilitating the 'tilting' of casks.
604. B. Britten, Anerley—Projectiles.

Dated 19th March, 1855.

605. B. Cook, Chester-street, Kennington—Consuming smoke.
606. G. Lowry, Manchester—Lubrication.
607. J. Rimmell, Covent-garden—Substitute for turpentine. (A communication.)
608. E. R. Tayerman, 79, Pall-mall—Portfolios.
609. R. Howson, Lancaster—Screw-propeller.
610. V. Scully and B. J. Heywood, Dublin—Regulating supply of gas to gas-burners.
611. J. Taylor, Southwark—Consuming smoke.
612. F. A. Chartraire, Paris—Fastening gloves, collars, &c.
613. P. Roehrig, Paris—Alimentary substance.
614. L. H. Crudner and F. L. Koebrig, Tottenham-court-road—Ventilation.
615. J. Smalley, Wigan—Railway-carriage axles.
616. R. E. Hodges, Southampton-row, and C. Murray, Manor-place, Walworth—Door-springs.
617. A. R. Terry, 1, Adelphi-terrace—Copying letters.
618. W. Smith, Little Woolstone, Fenny Stratford—Ploughing.

Dated 20th March, 1855.

610. A. White, Great Missenden—Swinging beds.
620. J. Musgrave, Bolton-le-Moors—Steam-engines.
621. W. Taylor, Poolstock, Wigan—Pickers for power-looms.
622. T. M. Tell and F. Squire, 74, King William-street—Weighing-machine for detecting base coin.
623. T. Stevenson, Little Bolton—Casing yarns.
624. Earl of Aldborough, Wicklow—Aërial navigation.
625. C. Marsden, Kingsland-road—Tent-poles.
626. E. T. Bellhouse, Manchester, and D. Longsdon, Grafton-street, Fitzroy-square—Materials for coverings of buildings.
628. A. E. L. Bellford, 32, Essex-street, Strand—Governor. (A communication.)
629. I. Rogers, North Haverstraw, U.S.—Treating iron ores.
630. A. V. Newton, 66, Chancery-lane—Forming moulds for casting. (A communication.)

Dated 22nd March, 1855.

631. W. Miller, North Leith—Prevention of smoke.
632. J. Morrison, Birmingham—Metallic pens.
633. T. C. F. Lecour, Paris—Locomotion on canals and rivers.
634. J. Biden, Gosport—Marine engines.
636. M. Semple, Plymouth—Railway-brakes.
637. W. MacNaught, Rochdale—Spinning machinery.
638. C. Carnell, Philadelphia—Bricks.
639. J. S. Russell, Millwall—Shipbuilding.

Dated 23rd March, 1855.

640. G. Whyatt, Openshaw—Machinery for cutting piled goods.
641. J. H. Johnson, 47, Lincoln's-inn-fields—Combing machinery. (A communication.)
642. J. H. Johnson, 47, Lincoln's-inn-fields—Hydraulic motive-power engines. (A communication.)
643. H. J. Morton, Leeds—Gasometers.
644. C. F. Behn, Commercial Sale-rooms, City—Moulds for casting metal. (A communication.)
645. F. Ransome, Ipswich—Artificial stone.
646. W. Young, Queen-street, Cheapside—Fireplaces.

Dated 24th March, 1855.

647. J. Willis, 75, Cheapside—Umbrella and parasol frames.
648. J. L. Bachelard, 3, Charles-terrace, Old Kent-road, and H. Harvey, 73, Denbigh-street, Pimlico—Animal manure.
649. U. Scott, Duke-street, Adelphi—Carriages.
650. R. J. Jesty, King's-cross — Indicating apparatus between railway-carriages.
651. D. Elder, jun., Glasgow—Moulding metals.
652. J. Niven, Keir—Paper and textile materials.
653. T. F. E. Clewe, Paris—Locomotive engines, tenders, and railway-carriages.
654. Major-Gen. G. G. Lewis, C.B., Woolwich, and J. Gurney, St. James's-street—Knapsack, convertible into a bed, a litter, or a tent.
655. W. Brown, Gresham-street—Preparing sewing-silk.
656. L. F. Edwards, New Bridge-street—Furnaces. (A communication.)

Dated 26th March, 1855.

658. R. S. North, Gorton, Manchester—Permanent way and sidings.
660. J. Gedge, 4, Wellington-street South, Strand—Machinery for forming curves. (A communication.)
662. C. A. Barrett, W. Exall, and C. J. Andrewes, Reading—Threshing-machines.
664. J. H. Johnson, 47, Lincoln's-inn-fields—Flax-dressing machinery. (A communication.)
666. C. A. Busson, Paris—Feeding apparatus, applicable to machines for treating textile materials.
668. F. Crossley, M.P., Halifax—Mosaic rugs.
670. A. W. Williamson, University College, Gower-street—Fireplaces.

Dated 27th March, 1855.

674. J. C. Bourne, Holmes-terrace, Kentish-town—Photographic apparatus.
676. W. Yates, jun., Woburn-place, Russell-square—Treatment of grain from which beer or spirit has been made.
678. J. Getty, Liverpool—Vessels.

Dated 28th March, 1855.

680. G. L. Turney, Wood-street, Cheapside—Packing pins and needles for sale.
682. J. S. Perring, Radcliffe—Permanent way.
684. F. E. Hudde and J. B. E. Fouquet, Paris—Pyrometers.
686. W. Dray, Swan-lane—Gear. (A communication.)
688. E. H. Becker, Altham—Projectile.
690. T. M'Low, Middle-row, Holborn—Screw-propellers.
692. J. Peabody, Old Broad-street—Motive power by action of wind. (A communication.)

Dated 29th March, 1855.

694. J. Gedge, 4, Wellington-street South—Stopping railway trains. (A communication.)
696. M. J. T. Gillot and C. C. Beauvois, 30, Upper Charlotte-street, Fitzroy-square—Purifying grain, &c.
698. J. Porritt, Stubbins Vale Mills, near Ramsbottom—Steam-engines.
700. J. Blair, Glasgow—Hats.
702. J. H. Johnson, 47, Lincoln's-inn-fields—Anchors. (A communication.)
704. W. James, Crosby-hall-chambers, London — Screw-bolts.

Dated 30th March, 1855.

706. H. W. Parnell, 13, Bryanston-square—Ships and boats.
708. W. Swain, Birmingham—Furnaces.
710. G. H. Babcock and A. M. Babcock, Westerly, Rhode Island—Polychromatic printing presses.
712. J. Morgan, Manchester—Candles.
714. E. V. Neale, Russell-place, and T. Dawson, King's Arms-yard—Umbrella-handles, &c.
716. T. W. Bunning, Newcastle-upon-Tyne—Steam-engines.

Dated 31st March, 1855.

718. C. Whitley, Manchester—Drilling machinery.
720. W. Corbitt, Rotherham—Warming and ventilating.
722. W. E. Newton, 66, Chancery-lane—Centre-bits. (A communication.)
724. G. F. Wilson and G. Payne, Belmont, Vauxhall—Treating oils.
726. E. and M. Abbott, Horningsea, Cambridge—Stays.

Dated 2nd April, 1855.

728. A. E. L. C. Finimerhaus, Liege—Forcing projectiles.
730. J. Shand, 245, Blackfriars-road—Fire-engines.
732. C. Crews, 8, Montague-terrace, Bow-road, and H. G. Gray, St. James's-street—Disinfecting compounds.
734. R. Peyton, Birmingham—Iron gates and fences.
736. W. Lund and W. E. Hipkins, Fleet-street—Corkscrews.

Dated 3rd April, 1855.

738. R. E. Witty, 9, Torriano-avenue, Camden-road-villas—Reflecting solar light.
740. T. Prideaux, Birmingham—Draining plough.
742. H. Powers, Florence—Tiles.
744. W. E. Gill, Totness, and H. B. Sheridan, Parson's-green—Fish-oil.
746. J. Maas and J. Adams, White Hart-yard, Southwark—Mills for grinding grain.
748. H. R. Fanshawe and J. A. Fanshawe, North Woolwich—Waterproof fabrics.
750. M. Evrard, St. Etienne—Drawing compressor.
752. C. Nickels Albany-road, and J. Hobson, Leicester—Weaving pile-fabrics.

Dated 4th April, 1855.

754. R. Hills, Caroline-place, City-road; T. Miles, Queen-street, Finsbury, and H. Monument, Caroline-place, City-road—Corking or stopping bottles, jars, &c.

Dated 5th April, 1855.

736. T. Squire, Latchford, Chester—Removing hairs from hides.
758. I. Carlhian, Paris, France, and F. I. Corbière, 27, Castle-street, Holborn—Soda-water.
760. J. Brazier, Wolverhampton, Stafford—Repeating fire-arms.
762. D. Lane, Cork—Obtaining power by water.
764. A. Longbottom, Soho foundry, Meadow-lane, Leeds—Preparing sand, &c., for casting. (A communication.)
766. P. Arrive, 7, Spencer-street, Darnley-road, Gravesend—Safety-valves.

Dated 7th April, 1855.

768. R. W. Waithman, Bentham-house, York—Manufacture of lint, &c.
770. A. Rollason, Birmingham—Improvements in photography.
772. R. Stones, Kingston-upon-Hull — Improvements in taps or cocks.
774. J. Aresti, Greek-street, Soho-square—Obtaining improved effects upon drawings washed or painted on stone.
776. D. G. Jones, M.D., 14, Harrington-square, Hampstead-road—Farinaceous food.

Dated 9th April, 1855.

778. J. C. Kay, Bury, Lancashire—Pressure and vacuum gauges.
780. E. O'Callaghan, Lieutenant in Her Majesty's 51st Light Infantry—Projectiles.
782. W. Bull, Ramsey, Essex—Slicing turnips.

Dated 10th April, 1855.

784. W. Ricketts and T. Bulley, Stepney — Ornamental designs on painted or japanned table-covers.
786. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Steam-boilers.
788. J. H. Johnson, 47, Lincoln's-inn-fields—Machinery for combing wool, &c.
790. L. Monzani, widow and administratrix of W. T. Monzani, late of St. James's-terrace, Blue Anchor-road, Bermondsey—Folding-stools and chairs.

Dated 11th April, 1855.

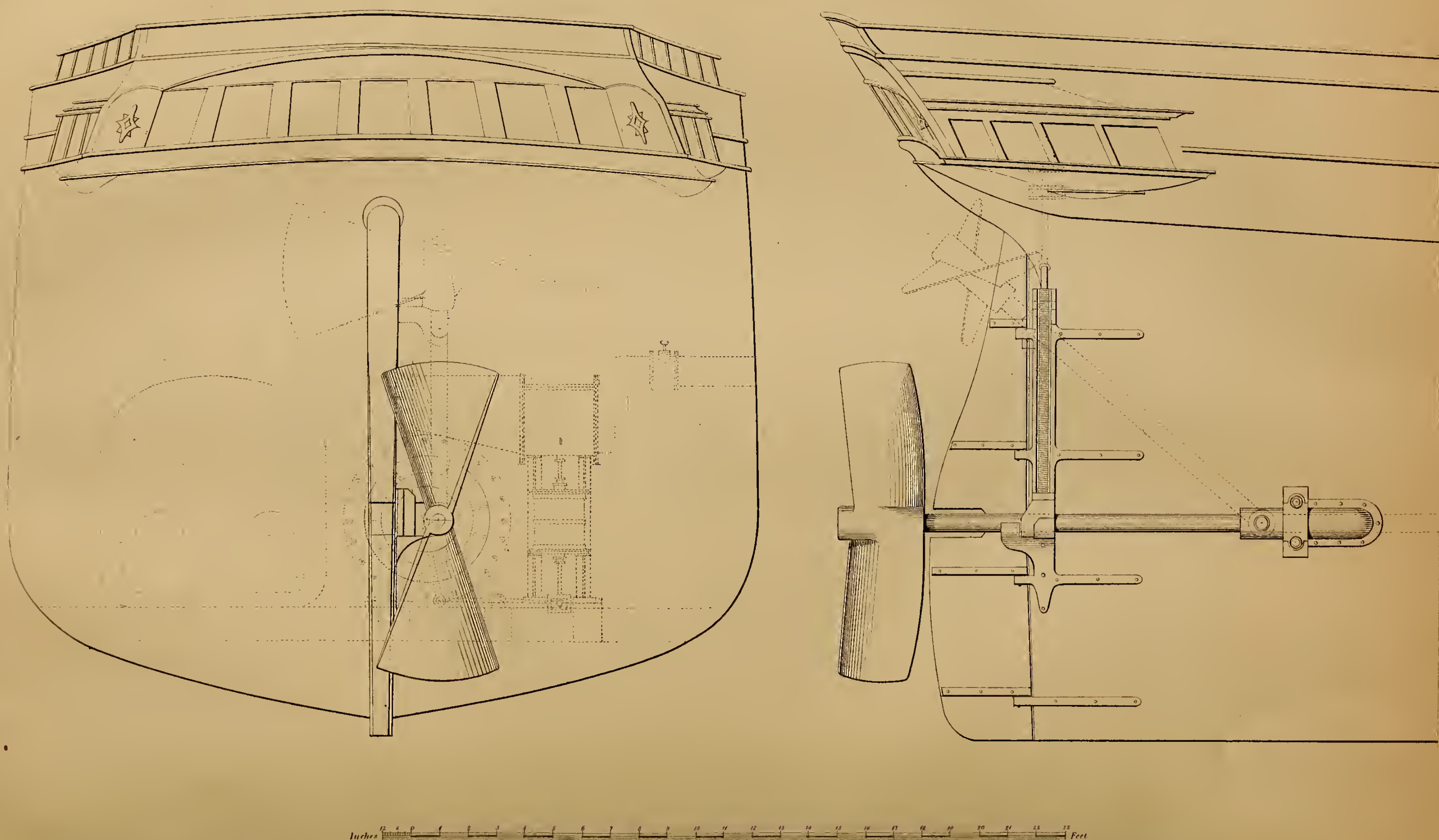
800. E. Pasquier, Rheims, France—Machine to be used for drying wool, &c.
806. S. Hjorth, Copenhagen—Magneto-electric battery.
807. S. Hjorth, Copenhagen—Electro-magnetic machine.
808. S. Hjorth, Copenhagen—Electro-magnetic machine.

DESIGNS FOR ARTICLES OF UTILITY.

1855.

Mar. 23, 3699. Wheatman and Smith, Sheffield, "Wheatman's mill saw key tiller."
" 24, 3700. Price's Patent Candle Co., Belmont, Vauxhall, "Hospital stove."
April 4, 3701. Benjamin Wheeler, Albert-street, Nottingham, "Gas fire-brick."
" 5, 3702. T. De la Rue and Co., Bunhill-row, "Fastenings for portfolios, and other covers containing papers and documents."
" 5, 3703. Foster, Porter, and Co. 47, Wood-street, "The alliance shawl."
" 7, 3704. William Greig, Robert Taylor, and John Chandler, Richardson-street, Bermondsey, "Improved can, jar, or case."
" 10, 3705. Nehemiah Brough, Cox-street, Birmingham, "Clasp or buckle."
" 11, 3706. Thomas Frederick Hale, Narrow Wine-street works, "Improved sling-action case beer-engine."
" 18, 3707. Alfred Emett, 13, Mount-pleasant, Liverpool, "Emett's chimney-top, for the prevention of smoky chimneys, &c."
" 18, 3708. Knight, Merry, and Exley, Birmingham, "Trench and portable cooking-lamp."

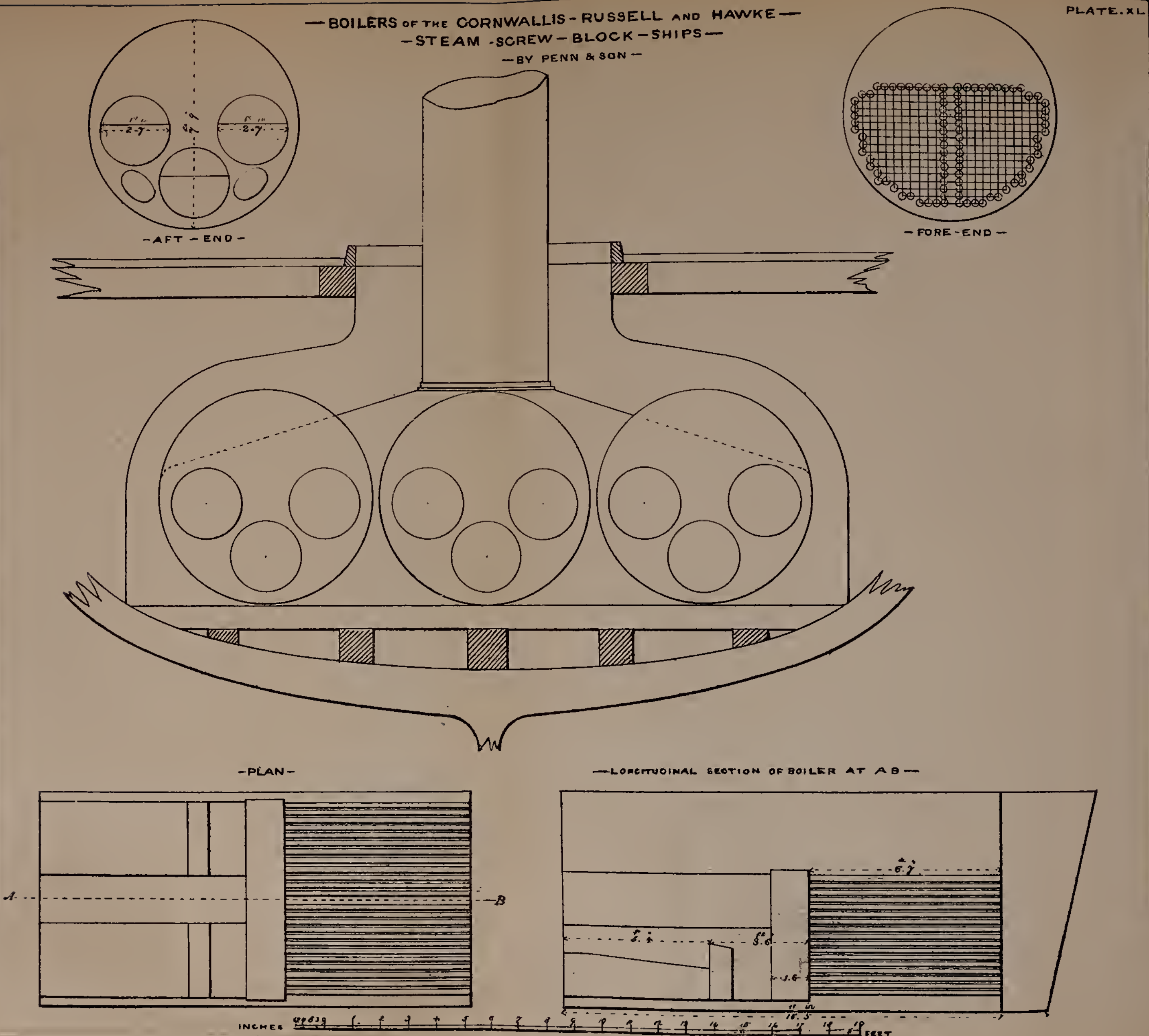
WIMSHURST'S MODE OF RAISING THE SCREW.



Drawn on Stone by Malby & Sons

BOILERS OF THE CORNWALLIS – RUSSELL AND HAWKE – STEAM – SCREW – BLOCK – SHIPS –

– BY PENN & SON –



ATE.XL

KNOWLES'
PATENT SAW & SAW MILL.
NEW-YORK, U.S. 1854.

FIG. 1

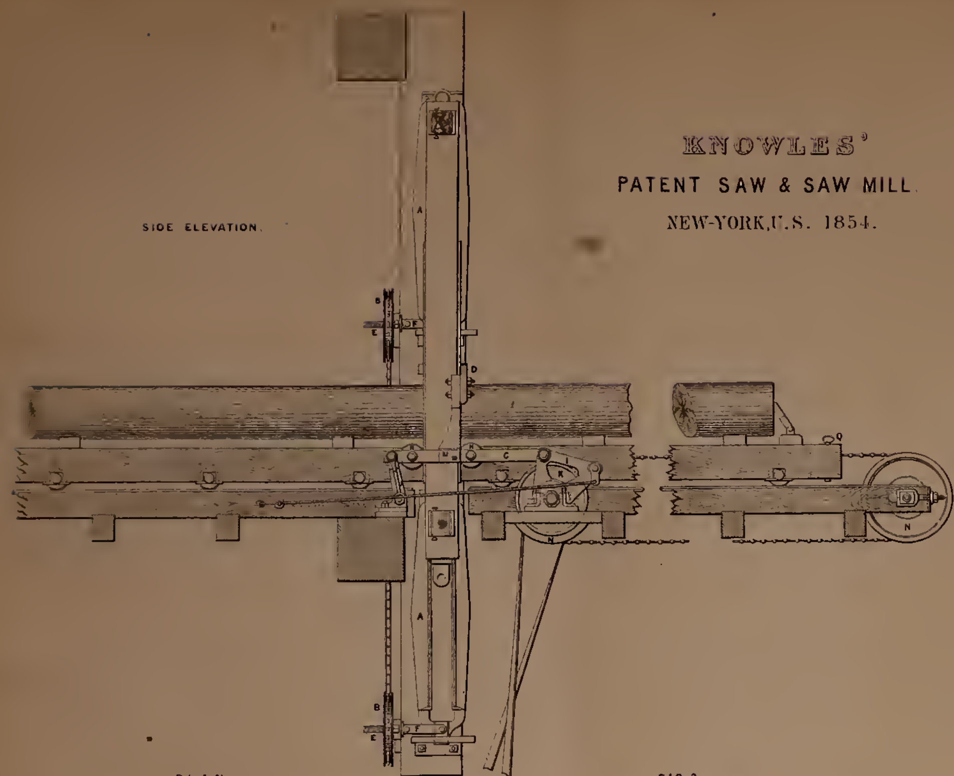


FIG. 2

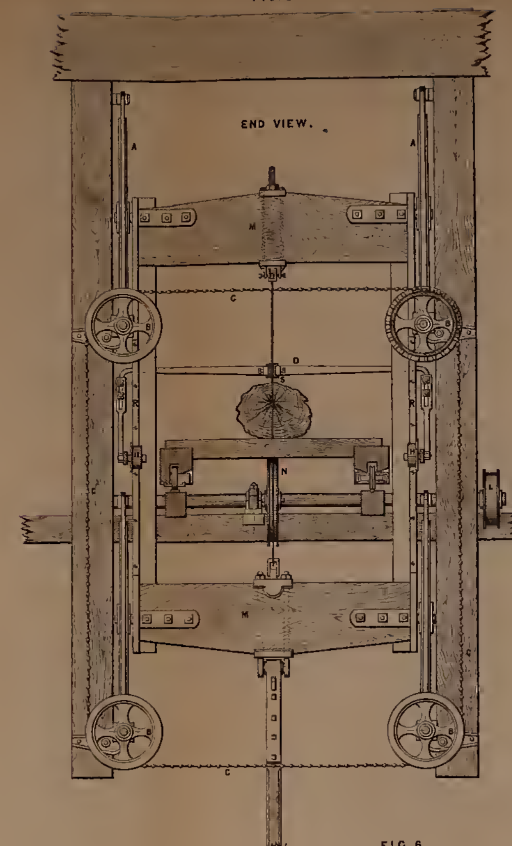


FIG. 4

FIG. 5

PLAN.

FIG. 3.

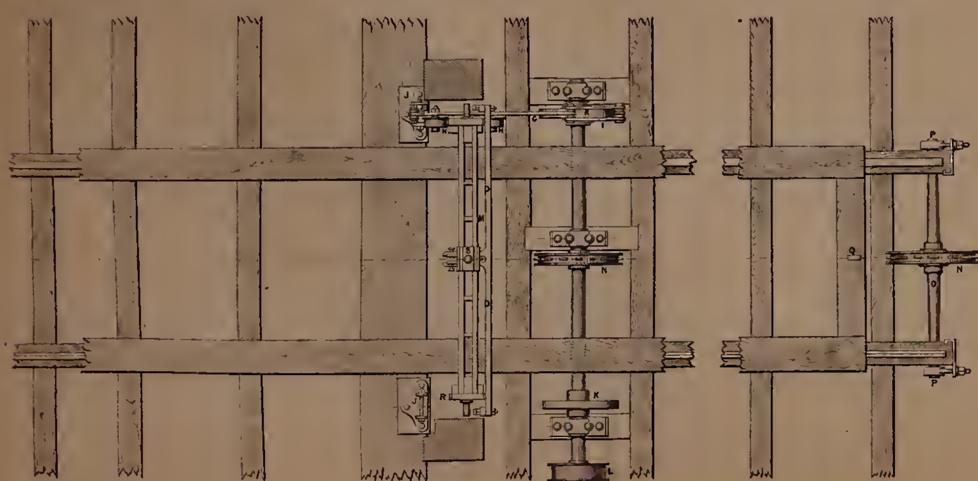
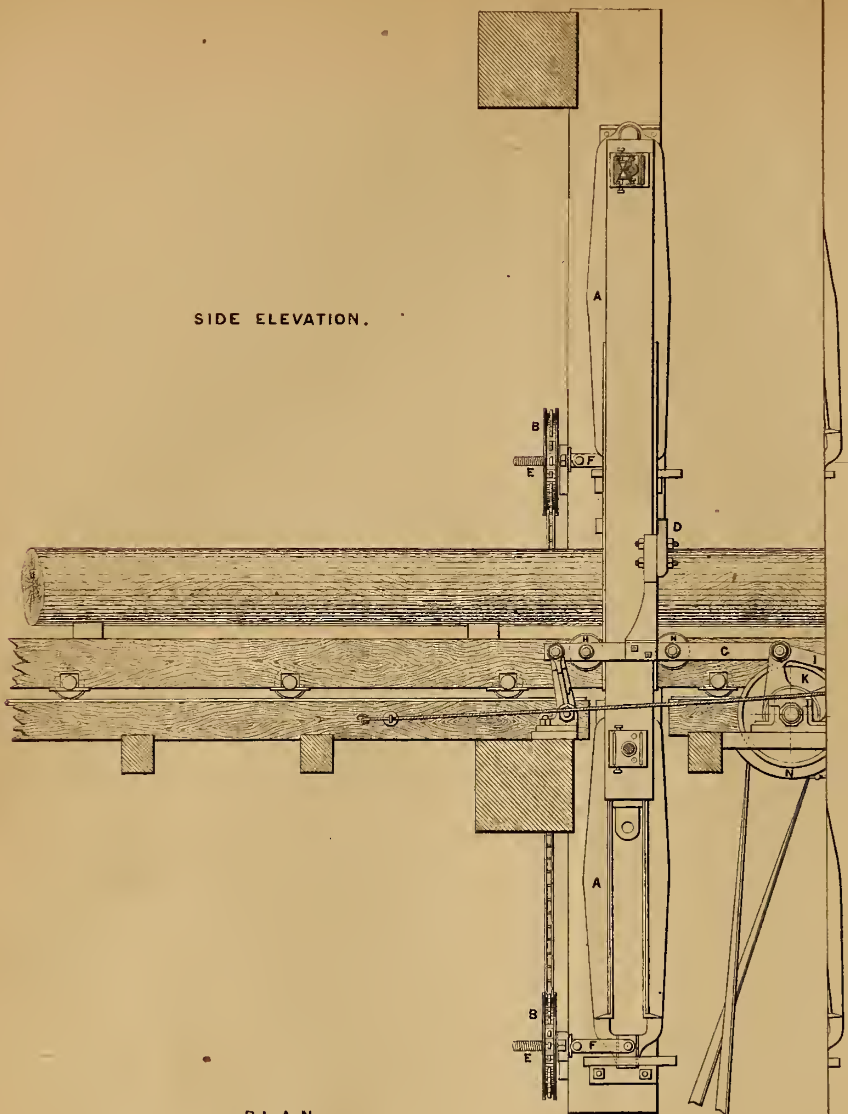


FIG. 6.

FIG. 1.

SIDE ELEVATION.



PLAN.

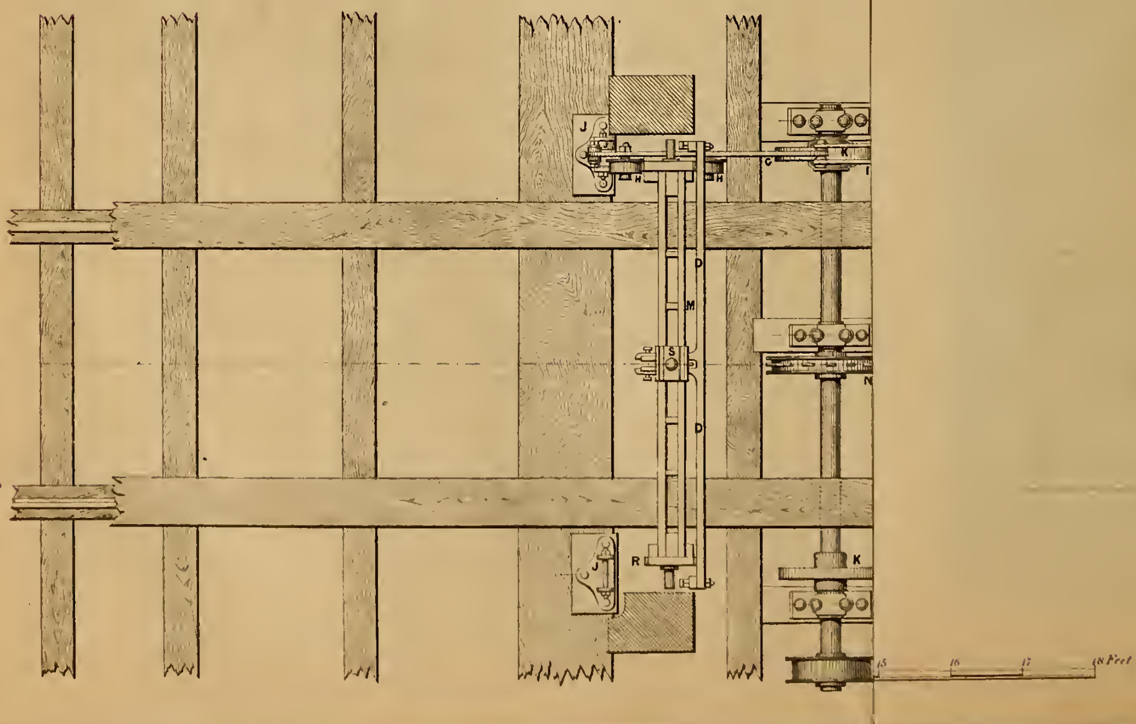
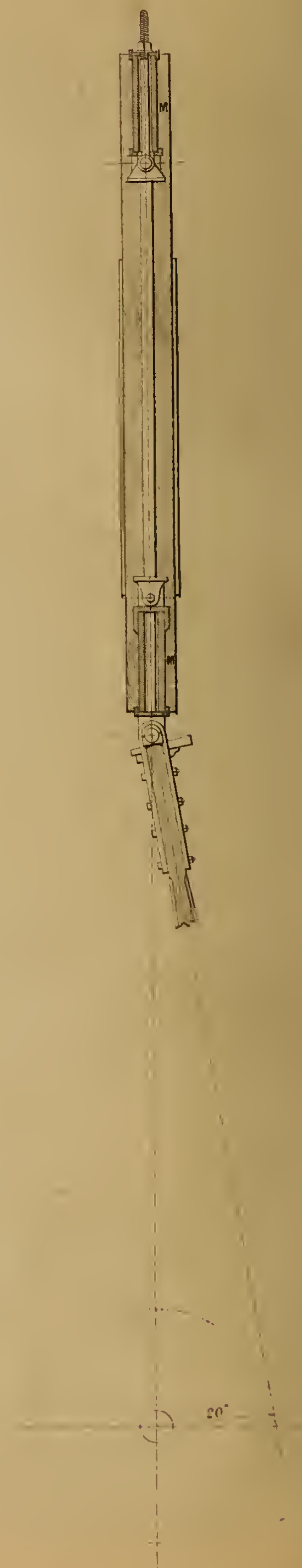


FIG. 5.




Port Manverse
C. Charles
GULF OF ST LAWRENCE
NEW FOUNDLAND
NOVA SCOTIA
NEWFOUNDLAND C. BANK
Lane for Steamers to America
Lane for Steamers to Europe
Boston
New York
Philadelphia
C. Charles
C. Hatteras
AZORES
IRELAND
C. Finisterre
Lisbon
St Vincent
Straits of Gibraltar
MADEIRAS
C. Blanco
CANARY ISLANDS
C. Bojador
BERMUDAS
U.S.S. Vincennes Nov. Dec. & Jan 1849-50
FLORIDA
New Orleans
GULF OF MEXICO
Tampico
CUBA
HAYTI
CARIBBEAN SEA
Windward Isles
Barbadoes
Bay of Panama
Amazon R.
St Pedro Rocks
CAPE VERD ISLANDS
SENEGAMBIA
Monrovia
Shape of Doldroms in Spring in Winter
May
March
Feb
April
Jan
Dec
Ashbee & Dangerfield lith.

THE ARTIZAN.

No. CXLIX.—Vol. XIII.—JUNE 1st, 1855.

THE NEW HIGH-PRESSURE BLOCK-SHIPS.

(Illustrated by Plate xl.)

We had the pleasure the other day of passing through Spithead, and were not a little gratified to see the respectable and really man-of-war appearance of the new *blocks*. They are five in number—the *Pembroke*, *Hastings*, *Hawke*, *Russel*, and *Cornwallis*.

In our sketches of the *Pembroke's* boilers in The Artizan for April last, we there referred to these ships, and we do so again with satisfaction. Their formidable appearance at Spithead is a fact highly creditable to the resources and enterprise of our engineers: that five formidable batteries, mounting 300 guns, should have been in the short space of about four or five months converted from *sailing* into useful modern screw ships, is worthy of notice.

We had also the pleasure of inspecting the mechanical arrangements and fittings, and they are really of the most superior description, as exhibiting the screw-engine and boiler in their most simple and effective styles for purposes of war.

The *Pembroke* and *Hastings* have been fitted by Messrs. Maudslay, Sons, and Field. Illustrated sketches of the *Pembroke's* boilers will be found in The Artizan for April, pp. 75 and 76. The engines of the *Pembroke*, by Maudslay, are the same as the illustrations in the "Notes on Designing Steam Machinery, No. ix.," p. 74, of The Artizan.

The *Hawke*, *Russel*, and *Cornwallis* have been fitted by Messrs. John Penn and Sons; their engines are on the well-known trunk principle. We need hardly remark that the trunk is one of the most simple and compact of marine engines; yet the difficulty of keeping the trunk glands tight, and the large radiating surface of the trunk exposed to highly-charged steam, are objections which cannot be overcome, or, at any rate, will prevent its coming into general favour for high-pressure engines.

We are glad to have it in our power to present our readers with illustrations of the boilers of the *Cornwallis*, *Russel*, and *Hawke*, by Penn.

Number of tubes in three boilers...		1,008
Length of tubes ...		6 ft. 7in.
Diameter inside of ferrules		$1\frac{1}{2}$ in.
Fire-grate surface ...	101·25 sq. ft.	= ·50 sq. ft. per H.P.
Heating surface in tubes ...	3,474	= 18·90 sq. ft. "
" " in furnaces and flues	306	
Area through tubes ...	1,781 in.	= 8·9 inches. "
Nominal horse power ...		200
Pressure on the safety-valve ...		60 lbs. on the inch.

On comparing these boilers with the *Pembroke* and *Hastings*, by Maudslay and Co., we are inclined to favour the former, especially where there is plenty of height below the water-line.

We noticed an objectionable point in the *Pembroke's* boilers, viz., the great length of small tubes, 8 feet 1 inch: they would, we were apprehensive, be very sluggish in first raising steam, and such, we are informed, was the case. No amount of coaxing or bullying could get up steam under three hours; though, after steam was up, it was maintained very freely at full speed.

The boilers of the *Cornwallis* class, with tubes 6 feet 7 inches long, get steam up comfortably, we are told, in one hour, and maintain it freely at full speed.

On examining the published reports of the trials of the three ships, we remarked that the *Hawk's* speed was 6·5, the *Russel's* 6·6, and that the *Cornwallis* was 7·1 knots per hour.

The trials of the Messrs. Maudslay's ships gave in the case of the *Hastings* 6·7 knots per hour, while the *Pembroke* gave 7·6 knots per hour. These facts are worthy of notice, as showing how very much depends on the *form* of the ship's body; to no other cause can we ascribe this increase of speed.

The pitch of the screws of the *Cornwallis* class, by Penn and Sons, is 9 feet 6 inches; the revolutions of the engines, from 95 to 100 per minute.

The pitch of the screw of the *Pembroke* class, by Maudslay, Son, and Field, is 12 feet; the revolutions of engines, about 80 per minute.

THE FLOATING BAKERY AND FLOUR-MILL FOR THE TROOPS IN THE EAST.

The Authorities, with a spirit much to be commended, as exhibiting proof of a desire to benefit by such public suggestions as may appear useful, have fitted up two mercantile steamers, of about 500 tons each, one as a bakery and the other as a flour-mill, for supplying the troops in the East with fresh-baked bread, which cannot but prove of the utmost importance both in keeping up the spirits of the healthy, and in improving the convalescence of the sick. The bakery consists of two capacious ovens, formed amidship the vessel, with the usual facilities for mixing and kneading. The flour-mill consists of four pairs of stones, placed abaft the engine, so that they may be driven by the screw-shaft; a bulkhead separates the flour-mill from the engine-room, and against this bulkhead the smut machine is placed, and at the other end of the mill the dressing machine; the whole forming a very compact flour-mill, fitted up by and from the plans, we were informed, of Mr. Fairbairn, of Manchester. When we inspected this floating flour-mill, the machinery was in operation, and appeared to be working very smoothly; but the tremulous and rolling motions created by the screw plunging in the still water of the dock was anything but promising for the operations of a flour-mill. One would have supposed that, in fitting up a floating flour-mill, a steamer would have been chosen in which the screw could have been raised up out of the water when the mill alone was required, or else have adapted the machinery to the circumstances of the case, and made the screw to disengage in some manner ; but no such arrangement appeared to have been made, and we repeatedly saw the screw splashing away and creating a fearful commotion, to the infinite peril of some adjoining craft, which it nearly sunk, with their cargoes of marine-boilers on board.

The two steamers which have been thus converted into the *Abundance* (the bakery), and the *Bruiser* (the flour-mill), are fitted with Stephenson's vertical inverted engines; and as we happen to have a few notes by us on the dimensions and performance of these engines, it will be a very easy matter to make a closely approximate estimate of the money wasted in not having the screw to disengage. The diameter of the cylinders is 3 feet ; length of stroke, 2 feet 3 inches ; and the nominal horse power, 40 (each engine) ; but their combined working power, with a pressure of 9 lbs. to the square inch, and making 76 revolutions per minute, is nearly 95 horse power. These data, we may observe, are the results of actual experiment in a trial-trip of a steamer of this class from the Tyne to the Thames.

Now, since we know that the power required to work a screw is the same whether the vessel be moored or free to move, with a difference in the velocity of the machinery only, we will be rather under than above the mark in taking 95 as the horse power required to work the screw when the mill is moored, because the gearing of the mill is, no doubt, proportioned to work the stones at their proper speed when the piston is passing through its ordinary space ; in which case our estimate gives, probably, but half the power dissipated in uselessly working the screw ; and 95 horse power, working twelve hours per day, requiring 10 lb. of fuel for each horse power per hour, at £2 per ton, gives very nearly £3,650 as the sum which poor, easy-minded, betaxed John Bull will have to stump in the next year's Naval Estimates, for no other earthly purpose than frightening the fishes in the Black Sea—unless it occurs to the engineers out there to obviate this unnecessary expense, and they can devise an expedient such as taking out a length of screw-shafting. But, since the mill should be working in a harbour in still water, so should it possess the means of instant locomotion in case of danger ; a means which the raising of the screw out of the water in the usual manner would have given it.

WIMSHURST'S IMPROVEMENTS IN AUXILIARY SCREW STEAM-VESSELS.

Ere the screw had attained a position as a propelling agent, and when but slightly known even as an experimental means, Mr. Wimshurst had done much toward its practical use by the application of his skill and scientific attainments as a practical ship-builder.

The *Archimedes*, the first of the experimental screw-vessels, was built by him ; and although the results of the early experiments were not fully as satisfactory as had been expected and hoped for, yet, for so novel an application, the success attained will, upon looking back to the time at which these experiments were made, bear comparison with—nay, stand out in bold relief amongst experiments in almost every other description of scientific works, tending to effect so great a revolution in the departments of science to which they belonged. True, the screw used in the *Archimedes* was not of the form best suited to the work ; yet there were those elements of success which required but to be tried experimentally, and, after careful investigation, readily exhibited in what respect the then form of screw was wrong.

In building the *Archimedes*, Mr. Wimshurst had the tact to perceive that which would be required in the construction of the stern of vessels to render them most suitable for the application of the screw-propeller. In 1841, he patented certain improvements in the building of steam-vessels for the reception of the screw-propeller ; which improvements, Mr. Wimshurst contends, were essential to the success of the screw, and are peculiarly his. Mr. W. also contends that the neglect of carrying out his mode of construction in vessels built subsequently to his patent explains, in a great measure, the indifferent success attending the application of the screw in those cases. Be this as it may (for all inventors seem disposed to lay claim to the largest amount of merit), one thing is certain—that Mr. Wimshurst moved very early in the history of the screw-propeller, and made considerable strides in advance of the popular notions of its usefulness. In 1842, Mr. Wimshurst had built a second vessel, the *Novelty*, of 328 tons B.M. This vessel was fitted with a pair of 12 horse power engines, and gave a speed of eight knots per hour. This appears to have inspired Mr. W. with great confidence; for we find him at this time challenging the world for £1,000 to a trial of any paddle-wheel steamer of double the power against his *Novelty*. And about the same time he was actively engaged in forming a company for realising the working the screw-propeller principle, under the name of the Submerged Propeller and Auxiliary Steam-ship Building Company; and he has ever since employed himself with screw-propelling matters.

In aiding Mr. F. P. Smith in carrying out his experiments, Mr. Wimshurst well entitled himself to credit for being thoroughly practical and also valuable as a coadjutor, and he, possibly, like Mr. Smith, may not have reaped the reward to which his ability and devotion to the screw-propeller entitle him.

It would appear that, dissatisfied with the existing modes of applying the screw and its driving shaft, Mr. Wimshurst set about experimenting to ascertain whether or not a better or more simple arrangement could be effected ; and the result was, that he found the propelling shaft and the screw need not be in the centre line, or in a line over the keel of the vessel, and that if applied on one side of the keel, with the screw overhanging beyond the rudder, the necessity for cutting away the dead wood to receive the screw, the loss of power occasioned by the stern-post, &c., being dragged through the water, together with the inconvenience of getting at the screw-propeller in case of damage, could all be avoided; also, that the great difficulty of raising it out of the water readily, when not in use for propelling, might be overcome. These are advantages which Mr. Wimshurst claims for his method of applying the screw.

Mr. Wimshurst also has some peculiar notions with reference to the steam-power for driving the propeller, and he claims to have succeeded in perfecting a rotary engine which will do a duty unapproachable by any other kind of steam-engine in use. Of this we can say nothing, but that an efficient rotary engine to drive the screw-propeller at a suitable velocity, without the intervention of wheel or other gearing, is a great desideratum, but hitherto unattained in practice.

In the present number, Plate xxxix. illustrates Mr. Wimshurst's arrangement of the screw-propeller, the mode of raising and lowering it, and shows his rotary engine applied as the motive power.

Respecting his improvements, he writes, that "he considers the defects of the present system of applying and driving the screw to be—

"1st. Loss of stowage and increased displacement, the weight and bulk of coals and machinery being sometimes half the amount of tonnage.

"2nd. Loss of sail-power; in some cases nearly 50 per cent., from dragging the after stern-post and propeller through the water when the vessel is under sail.

"3rd. The bad form of propeller, producing a loss of 30 per cent. of the power of the engines, besides a tendency to twist the stern of the vessel, in neutralising which the rudder must be put over in the opposite direction, thereby retarding the speed."

Now, Mr. Wimshurst states that his improvements remove these objections, and that by his portable propeller (which can readily be unshipped) he can propel a vessel of 2,000 tons at the rate of six miles per hour, through calms of ten days, with one of his engines of 100 horse power, and with 60 tons of coals, in lieu of two engines of the ordinary kind, of 200 horse power, and requiring, at the least, 350 tons of coals ; and he adds, that "we may fairly calculate upon making a voyage to Australia in 60 days, with sail and steam combined, carrying a profitable quantity of cargo and passengers."

In support of his assertions, he presents the following tabular statement of the cost, disbursement, and profit and loss accounts of a vessel constructed according to his designs, as compared with three other vessels, all of the same tonnage, but variously propelled:

The first vessel noticed in the tabular statement is a paddle-wheel ship of full power, which, for long voyages (the Australian trade, for instance), cannot be worked to a profit; for this class of vessel cannot carry a sufficient quantity of fuel, and is obliged to call at several stations.

The second vessel noticed is a full-power screw-propeller vessel, which has other objections as well as the above (as have all the present screw-steamers), and amongst them is that of dragging the after stern-post and propeller at a great velocity through the water.

The third vessel is an auxiliary screw steamer, such as proposed by Messrs. Gibbs and Bright, *i. e.* with an engine to work the propeller when the vessel is under sail; which sailing qualities will be much more perfectly applied to the fourth vessel in the tabular statement, which is Wimshurst's portable propeller vessel.

The whole of the vessels in the table are of 2,000 tons, and are supposed to be capable of carrying 2,500 tons: therefore, the object is to show the relative qualities of each vessel. The two former, it will be seen, show a loss, but the two latter a large profit, by the saving of fuel and space for cargo.

The cost of the hull of each vessel, as well as the wages and victualling, are in each case the same, and without passengers or mail contracts: therefore, it may be clearly seen which of the vessels will work to a commercial benefit by a profit and loss account, which is similarly tabulated, and was published in 1849, with the intention of preventing the loss of so many millions to the country.

A Comparison of Four Steamers, 2,000 *tons each, to perform a voyage of sixty days' steaming, at nine knots per hour.*

Description.	Paddle.	Screw.	Gibbs and Bright's Auxiliary Engine.	Wimshurst's Portable Propeller.	Remarks.
Horses' power	600	460	212	140	
Cost of vessel	40,000	40,000	40,000	40,000	
Cost of engines	27,000	18,000	9,600	6,300	
Gross amount .....£	67,000	58,000	49,690	46,300	Ready for sea.
Disbursements.					
	£	£	£	£	
Consumption of fuel at 20s. per ton...	2,700	2,187	960	650	At 7 lbs. per H.P.
Wages and victualling	1,000	1,000	1,000	1,000	No passengers.
Insurance	836	725	618	556	At 7½ per cent.
Wear and tear	1,116	966	828	735	On gross at 10 p' ct.
Total ....£	5,652	4,878	3,406	2,941	
Loss of Stowage.					
	Tons.	Tons.	Tons.	Tons.	
Weight of engines...	500	350	160	100	
Weight of fuel......	2,700	2,180	960	650	
Total weight....	3,200	2,530	1,120	750	
Space for cargo	none	none	1,380	1,750	
At £5 per ton			× 5	× 5	
Gross amount proceeds	none	none	6,900	8,750	
Less disbursements ..	5,652	4,878	3,406	2,941	
Profit ....£	none	none	3,494	5,809	Profit.

Finally, he adds, the whole secret is the small amount of space occupied by the engines and fuel, to obtain the greatest amount of effective propelling force; and which advantages, Mr. Wimshurst states, will be found on adopting his plans, as above described.

ON THE DEFECTIVE CONSTRUCTION OF RAILWAY SWITCHES.

Having during the latter part of the year 1851 been professionally engaged in the erection of some works in connexion with one of our provincial railways, an accident occurred at an ordinary single throw-switch, which drew our attention to what appeared to us a defect in the construction of switches; a defect which had not up to that time been taken into consideration, but is now, we perceive, being entertained by railway engineers; namely, that of a weakness in the tongue-rails, and the flange of the tire, when impinging against the central part of them,

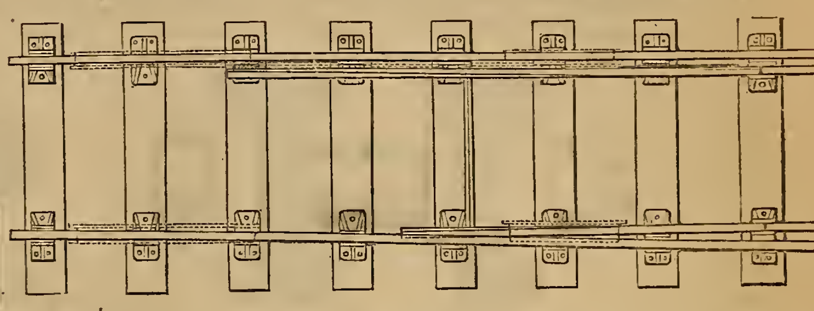


Fig. 1.—Scale, $\frac{3}{16}$.

where there is no lateral support, having a tendency to give a vibrating motion to the tongues, and so guiding the following pair of wheels on to a different line of rails from those on which the preceding pair of wheels are running. It is clear that if one pair of wheels of, say, a locomotive have passed on to the switch and impinged against the central part of one of the tongue-rails, and with the following wheels in such a position that if one of them be passing on to one of the tongue-rails at the instant its vibration is towards the fixed rail, then one of the wheels will be guided on to the wrong line of rails; and should this occur with the longest tongue-rail, the pair of wheels will pass on to a totally different line of rails from those on which the preceding pair are running, or be thrown off entirely: and it will immediately occur to many, that several accidents have taken place at switches which would appear to indicate that this had been the action of the points under the circumstances of the accident, and not, as has been so easily and frequently asserted, through the pointsman not keeping the switch well closed in those cases where the pointsman is required. And it will further be observed, that though the second pair of wheels may have passed a little distance on to the switch, and would appear to be sufficient to prevent the tremor caused by the first pair of wheels, such, however, may not always be the case in practice, as the tongues of Wild's patent switch are housed under, and, for a considerable distance, lower than the fixed rails, the wheels exercising only a lateral pressure against them, and so permitting the vibration of the tongues. A reference to Fig. 1, which is a plan of Wild's patent switch, will show at once the manner in which this vibrating action may be caused. The sketch represents what we may suppose to be the leading wheels of a locomotive, with the right-hand wheel impinging against the unsupported part of the short tongue-rail, when the tongue will be thrown from the fixed rail and a tremor communicated to the long tongue-rail on the other side by the distance-rod which connects them.

At the time of the accident to which we have referred, we commenced a few simple observations by standing on the foot-steps of the engine, so as to get as nearly as possible a vertical view of the switch, and watching the action of the tongue-rail as the engine passed over, and the vibration was truly alarming. The engine upon which we made these observations was that to which the accident occurred—one of M'Conochie and Claude's, of Liverpool, and well adapted for effecting this vibrating action of switches, the engine having but four wheels, the driving-wheels being close in front of the fire-box, whilst the leading-wheels were nearly under the centre of the smoke-box, leaving a space of about 12 feet between the wheels, so that the tongues had ample room to vibrate from the effects of the leading-wheels before, and as the driving-wheels passed on to them. Though having thus firmly impressed ourselves with a belief in the defective construction of switches, but becoming disconnected with railway engineering immediately after these observations were made, and thereby losing the opportunities of confirming our opinions by further experiment, and investigating the best source of improvement; however, we are in a position to direct attention to a matter which, there is no doubt, has been a fruitful source of many serious accidents—to discuss the merits or demerits of the plan which has been introduced on to the Great Northern Railway by Mr. Burleigh, and to offer such suggestions as may appear to us sufficient to meet the requirements of the case without much alteration or expense.

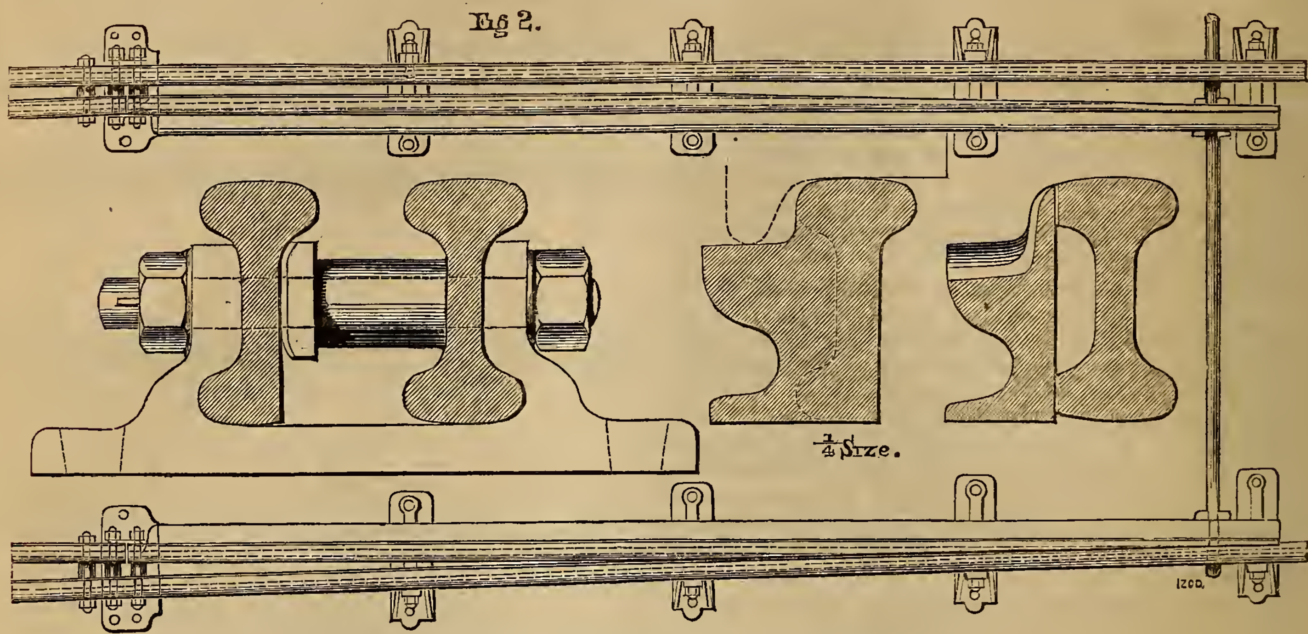


Fig. 2.—BURLEIGH'S RAILWAY SWITCH.—Scale, ½ inch to a foot.

Mr. Burleigh's plan, then, is represented by Fig. 2, with its attendant sections, and consists of rolling a projecting piece on one side of the tongue-rail, for supporting the flauge of the wheel in its transit over the switch, the surface of the projecting piece being depressed at its extremities, so as to receive the flange of the tire very gradually. Thus, while the object of the inventor is to prevent the cutting action of the wheel in crossing the fixed rail, the projecting piece receiving the weight of the passing load fulfils this object, giving at the same time a lateral stiffness to the tongue-rail, which, combined with the portion of the weight of the passing load thrown ou to it, will effectually prevent all vibration: but we very much question whether a plan which throws a part of the load on the flange of the tire (at points and crossings)—a part so vital to the safe keeping of the wheels on the rails—will find acceptance with railway engineers, while the expense of rolling special rails for the switches will be quite sufficient to induce others to attempt some simpler solution of the difficulty. Besides, if such be the cutting action of the flat part of the wheel (at least, comparatively flat,) in passing over a rail diagonally, what must the cutting action of the sharp flange be? Will it not cut its way into the projecting piece on the tongue-rail with tenfold more facility? What might be the advantage of giving the flange a flat bearing surface in combination with curved edges, and increasing the spaces between the wing and point rails, is another question, and perhaps worthy of consideration as a means of preventing the cutting action of a tire (which has been worn hollow) in crossing a rail diagonally; but we should still question the utility, and the safety, of giving the flange of the tire any bearing on the tongue-rails of switches. However, in other respects Mr. Burleigh's switch is, in our humble opinion, the safest which has yet been introduced into the railway system of this country: the tongue-rails, as well as possessing good lateral stiffness, are well connected at the tongues, where they are so liable to vibrate. Mr. Burleigh has effected similar improvements in crossings; but these we have not time to notice at present. We have presented our readers with the new switch without delay, because it is a question of first importance to the safety of the travelling public. The lamentable accident at Wolverton, a few years ago, will still be in the recollection of many: that accident occurred at a switch—besides others to which we need not now refer.

As Railway Companies, however, will not be very willing to pull up and renew all their switches, some expedient will no doubt be resorted to to prevent the vibration of the tongue-rails; and this can, no doubt, be effected. One plan—that of taking away the stretching-bar and connecting each tongue to a separate lever on a weigh-shaft in the switch-box—suggests itself at once as being both simple and efficacious; for by fixing the rod for the short tongue-rail to the long tongue-rail, any flexure of the latter rail would keep its own tongue the tighter against the fixed rail, and only have the effect upon the short tongue-rail of opening it a little more, which is of no consequence; while, if the points had to be opened, the prevention of auy vibration would be ensured by keeping the short tongue-rail firmly against the fixed rail: and this could easily be done by pinning the switch-handle in a quadrant while the wheels are passing over. This plan, it will be observed, would not in any way interfere with the self-acting properties of the switch, and would effectually prevent any appreciable vibration, and could be readily applied to all existing switches.

Having now fully pointed out the defective construction of many of our railway switches, and given Mr. Burleigh's plan for remedying the same, together with our own suggestions for rendering existing switches safe, we beg to commit the subject to the serious consideration of all whom it may concern, and trust that our labour will not have proved in vain.

ON LANES FOR THE STEAMERS CROSSING THE ATLANTIC.

By Lieut. M. F. Maury, U.S.N.

In the Notes of our American correspondent for the present month, at page 129, will be found a reference to the present paper, with which we have been favoured at the earliest moment for publication.

The subject is one of great importance to the mercantile-marine interests of the whole world, and we especially trust that those representing British interests engaged in commerce with America will fully appreciate the talent displayed by Lieut. M. F. Maury in the treatment of the subject he has so ably investigated. This paper contains matter for consideration beyond the questions treated of directly; and we doubt not that Lieut. Maury, in the course of his further investigations in connexion with the science, in which he already excels all other scientific investigators of these subjects, will laterally work out other important matters connected with meteorological phenomena.

In a letter to Walter R. Jones, Esq., President of the Board of Underwriters, New York, he writes—

"The subject has received a most laborious and patient investigation. Illustrative of the position assigned to each of these lanes, all the material afforded by abstract logs, containing the observations of not less than 46,000 days, concerning wind and weather, sea and currents, along the route of the proposed lanes, have been examined and discussed.

"I have risen from the labour entailed by this discussion greatly encouraged; for I find the adoption of the lanes, so far from materially lengthening the passages to and fro, will probably shorten the average to the west, and not increase the average to the east more than a few hours, if at all.

"While I am encouraged to believe that their adoption will not, therefore, materially prolong the time—and time, in steaming across the ocean, is, I am aware, a very precious thing—I also have the satisfaction of announcing with boldness that it will tend in no small degree to lessen the dangers of the sea. Is the expression too strong? I think not, if you will take it as meaning to lessen the *probability* of collision between steamer and steamer, steamer and sailer, and the *chances* of shipwreck by running ashore in the dark.

"Hoping that an examination of the subject may so impress the owners of these lines, those who underwrite for them, and those also who cross the sea in them, I have," &c. &c.

I duly received the communication requesting me to carry out the proposition, by projecting the two steam-lanes across the Atlantic, viz:—one for the steamers to *go* in, and the other for them to *come* in.

I at once addressed myself to the task, and after a careful examination of the somewhat ample materials afforded by this office (the Naval Observatory), I have at length the pleasure to submit charts with the lanes projected on them, together with other matter bearing upon the subject.

I have examined a number of the logs both of the Collins and the Cunard lines. The part of the ocean used by them in their voyage to and fro, between the meridians of 15° and 65° west, is, for the American, 300 miles broad, and for the English, 150 miles broad. The American road-way overlaps and includes the English. Consequently, there is a breadth of ocean 300 miles wide, in any part of which a sailing-vessel, by night or in the fog, is now liable to be brought into collision with the steamers.

Now, suppose we take this same breadth of ocean and lay off a lane twenty or twenty-five miles broad near its northern border, and another fifteen or twenty miles broad near its southern border, and recommend the steamers, when coming westwardly, to use the former, and when going eastwardly to take the latter; would not the adoption of the recommendation contribute to the safety both of steam and sailing vessels—of passengers and crews? I think so.

I do not mean to create the impression, by anything I say or do, that the adoption of these lanes would *do away* with collisions, or call for less vigilance, or relieve in any manner the shipmaster from his obligations to look closely to the navigation of his vessel—to be watchful, prudent, cautious, and careful. On the contrary, he must never relax his attention to the seaman's three L's, nor slight his water thermometer. The adoption of the lanes will simply lessen the *liabilities*, by diminishing the *chances* of collision, and to that extent make the navigation of the Atlantic *less* dangerous. So far from relaxing attention to the log, lead, and look-out, these lanes call for increased diligence on the part of the master, for that breadth only is given to them which will just make them broad enough to cover the probable errors in latitude of a good, careful navigator, after he has been two or three days without an observation. A narrower lane would be forbidding, from the difficulties of keeping in it; a broader lane would be mischievous, by relaxing its calls upon the attention of the master to keep his steamer in it, and by occupying so much of the ocean that sailing-vessels would not so willingly, because they could not so conveniently, give it up to the steamers.

If these lanes be adopted by the steam-ship companies, and engraved on the general charts of the Atlantic that are used by the vessels of the different nations, and marked as they are on the chart of the Atlantic, by Blunt, herewith sent, or as I have instructed the engraver to project them on the Track Charts, series A, of the North Atlantic, and as they are on Plate of Tracks appended (Plate xlii.), I have very little doubt that sailing-vessels would, in the process of time, make it a rule to edge off from the lanes, especially at night and in thick weather. In the first place, the lanes are so narrow, that if the sailing-vessel have to cross them, as in head-winds and in the progress of her voyage she not unfrequently will, she will be but a little while in them, and her master will then know on which side to watch for the danger. In the next place, if his course lie along the lane, and the winds be fair, he will, as night comes on, or as the weather grows thick, begin to think of the steamers and collision, and his own responsibilities, and then feel much more comfortable by edging off to one side and leaving the steam-track clear.

The average route of the steamers coming, as determined by the abstract logs on file here, crosses the meridians of 40°, 45°, and 50°, from forty-five to sixty miles north of the lane to America, and joins it on the meridian of 55°, and then runs nearly along with it to Sandy Hook.

The lane coming is, therefore, a better road than the average route at present used, and for these reasons, viz.: It is thirty miles shorter; it runs so far south of Cape Race and the Virgin Rocks, that no time need ever be lost in turning aside, when fogs prevail, to avoid these dangers, for it passes 100 miles south of Cape Race.

This statement, without any explanation, might appear paradoxical, for the nearer to Cape Race, the shorter the distance; yet, practically, it has not proved so, because vessels, especially in the fog, as they near this cape, have frequently to run one, two, three, or more hours to the southward to be sure of clearing it. When they are so running, they are not making much headway towards their port. So, on the long run, the attempt to shave Cape Race makes the average distance practically greater than it is by the lane. Indeed, it is greater than the statement above implies, for the distance which I have taken as the average by present routes is measured by straight lines from position to position, at noon.

The shortest distance possible for a steamer between Liverpool and Sandy Hook is 3,009 miles; the average distance actually accomplished is 3,069 miles, and the distance by the middle of the lane coming is 3,038. There is also another recommendation in favour of this lane to the west, which is this: It lies along the northern edge of the Gulf Stream, where there is an eddy setting to the westward often at the rate of a knot an hour. On the average, I assume that the set of this eddy will amount to twelve miles a day for three days and a half, or, say 40 miles. This makes the distance by the lane coming practically about 2,998 miles; or, allowing 20 miles for detour, we shall have 3,018 miles, which will shorten the average time of the passage this way three or four hours, with less risk of collision, and less danger from Cape Race by the way.

It may be urged against this lane that it cannot always be followed, on account of the ice, and that inasmuch as it crosses the Grand Banks, the steamers that ply in it may now and then run down a fishing-vessel. The reply is, that as far as the fishermen are concerned, they are now liable to be run down by the steamers both going and coming. Whereas, with the lane, that liability is incident to the steamers alone that are westwardly bound, and the fishermen will have the advantage of knowing pretty nearly where the steamer will pass, and which way she will be coming. And as for its being obstructed by ice, so as to compel the steamers, as it occasionally will, especially in May and June, to turn out of it now and then, the Erie Canal of New York is obstructed by ice the whole of every winter, but that does not prove it to be of no value; it only shows that it, like this lane, would be of more value to commerce if it were never obstructed by ice, or anything at all.

You will observe by looking at this lane upon the Blunt's Chart, that the Grand Banks afford a pretty good landmark which can be used in the thickest weather. Generally the water thermometer is found to fall as soon as you near these banks: it is generally a good landmark for them. The eastern edge runs north and south, and, therefore, affords an excellent correction for longitude. Having ascertained, by the lead, when the vessel first strikes this edge, then noting the soundings and the distance run before clearing the Grand Banks, the latitude will also be known with accuracy sufficient to enable the navigator to decide whether he be in or out of the lane, and if out, on which side. The lane crosses the Banks near their greatest width, 275 miles. If a steamer be crossing there in a fog, and in doubt as to her position, she can judge, by their breadth and the soundings, pretty nearly as to latitude. For instance, if the breadth of the Banks when crossed be less than 275 miles, but the soundings not less than 40 fathoms, the vessel has crossed the Bank to the north of the lane; but if she find herself in less than 30 fathoms, then she has crossed to the south of it. Should she, however, find herself in water that suddenly shoals to less than 20 fathoms, and as suddenly deepens again, then she is near the Virgin Rocks, or the rock and Nine-fathom Bank to the east of them, and her position is immediately known.

It should be recollected, however, that these lanes are not channel-ways in which steamers must keep or be lost. Gales of wind, ice, and other things, will now and then force a steamer out of them; and in such cases she will actually be where she is now, for she will then be in no more danger than she is now; only when she gets back into the lane she will be in less.

You will doubtless observe the advantageous position of the fork to Halifax, in the lane from Europe. As this lane approaches Newfoundland, it edges off to the south in such a manner as to render it impossible for a vessel so to miss her way as to get ashore. Suppose a steamer attempting this lane to be, when she nears the Grand Banks, 100 miles out in position (a most extravagant case), and that she be out on the Newfoundland side, she would, if behaving properly, be steering parallel with the lane; and if bound to New York, she would go clear of Cape Race. But she might be bound for Halifax, and, by steering west too soon, might run upon the land; but recollect that the lane to Halifax turns off *on soundings*, and a west course from where the lane from England strikes soundings on the Grand Banks will take you clear of everything. So, without the most gross neglect of the lead, and all the proper precautions which it is the duty of the shipmaster to take, it would seem impossible for him to run his steamer into danger here.

In the longitude of the Grand Banks, the lane to Europe is 200 miles south of the lane to America. As a rule, this lane for the eastern-bound steamers can be followed always, admitting that an exception now and then in practice will make the rule general. It will be observed that this lane runs E. 15° S. from Sandy Hook to the meridian of 70°, where it takes a course E. 12° N., towards its junction with the arc of a great circle, south of the Grand Banks. Though the distance by this lane, from Sandy Hook to this junction, is a few miles longer than the direct line, yet on account of the Gulf Stream it is in *time* the shortest distance that a steamer can take. From the Capes of Delaware it is obviously the shortest.

The distance from Sandy Hook to Liverpool, by this lane, is 106 miles greater than it is by the lane coming. But the lane going is in the Gulf Stream, which of itself will nearly, if not quite, make up for this difference. The *San Francisco* steamer was wrecked in the Gulf Stream; and from the time she was disabled till she was abandoned, she drifted at the rate of two knots an hour. When the *Great Western* steam-ship first came over, she stemmed the Gulf Stream, and was se back in it 175 miles during the voyage. Now, from the Grand Banks west, the track of the *Great Western* was not as much in the strength of the stream as this lane is, for she passed to the north of it. This trip, too, was in April, when the middle of the stream is well south.*

I may be excused for mentioning, in this connexion, an incident relating to the early history of ocean steam navigation. After this passage of the *Great Western*, I wrote a paper on the achievements of the New York packet ships, and pointed out on a chart the great circle route from New York to England, and commended it to the attention of those concerned in this new navigation. The paper, with the chart, was published in the "Southern Literary Messenger" (Richmond, Va.) for January, 1839. The editor sent a copy to Captain Hoskins, and he ever afterward went by the route recommended on that chart. His competitors stuck to the old rhomb-line route, and from that time Hoskins generally beat them, this way, about a day; and here is the explanation. They were set back in the Gulf Stream, 150 or more miles; he was set forward 40 or more by the eddy, and gained some 50 or 60 additional by the great circle, which made altogether about one good day's sail in his favour. The great circle, or Cape Race route, was not generally adopted, however, even when he left the line; and it has been mischievous, by tempting navigators to shave the cape too closely.

The current of the Gulf Stream is not only in favour of the lane going, but the gales are more favourable and the fogs less frequent than they would be by a more northerly route.

In order to enable you to judge knowingly as to the relative merits of these two lanes in this respect, I have, with the help of the most willing, zealous, and able corps of assistants that one ever had, and such as can be formed only of navy officers, examined and discussed abstract logs containing observations for no less than 46,000 days, on the winds, weather, the sea, and the currents, in the parts of the ocean through which these lanes pass. The result of that discussion I submit herewith for information, on a chart of engraved squares. (See Plate xliii.) The horizontal lines are there marked as per cents., each being counted as one, and every fifth one being a little more heavily ruled than the rest. The vertical lines marked 70°, 65°, 60°, &c., are meridians of longitude between which the lanes pass. Between each two of these meridians are twelve columns for the twelve months, beginning always with December, the first winter month. Thus, the navigator wishes to see what is the most foggy month in the lane to America, between the meridians of 70° and 75°. He finds on the plate the fog-curve for that hour, and his eye is immediately attracted to the remarkable peak formed by this curve, in the July column between these meridians; the meaning of which is, that, according to the averages derived from these 46,000 days, the probabilities are, that if he were to pass along this part of that lane one hundred times in the month of July, but in different years, he would find it foggy twenty-eight times; or, in other words, twenty-eight per cent. of the days in July are foggy along that part of the lane. Casting his eye farther along, he will see that fogs, at certain seasons of the year, are astonishingly prevalent from long. 55° to long. 45° (on the Grand Banks); and when he comes to count the columns, he will find that June is the foggiest of months. But the relief and the consolation is, that that is precisely at the season of the year when daylight is the longest; so that even here there is compensation.

Now he looks at the fogs for the lane going, and he is struck with the more modest flexures of the curve, and particularly with the fact that both the fog-curves almost invariably come down to the zero (0) line near the meridians: in other words, that the fogs are less prevalent in both lanes during the autumn and winter, when there is least daylight.

In like manner, he wishes to know as to his chances for meeting with

* The thread or axis of the Gulf Stream moves up and down in declination as the sun does, being farthest north in September, farthest south in March. Its limits are not accurately described on any general chart that I have seen.

a gale of wind as he passes along in the lane to Europe, and whether these gales will be adverse or fair—in other words, whether they will have easting or westing in them. Now he sees, under the head of "Lane to Europe" (chart appended), by the curve marked "fair gales," that the most stormy part along this line is between the meridians of 35° and 40°; that here, in January, it is blowing a gale of wind half the time (52 per cent.), while at certain other seasons of the year gales seldom or never occur. But these gales all have westing in them, and are, therefore, fair. The preponderance of fair gales along the lane to Europe, viz., all gales having westing in them, is very striking. The vessel will be running with these gales, and therefore diminish their strength. In like manner, the gentle flexures in the curve marked "head gales" denote how much less frequently gales with easting in them are to be met with in the regions through which this lane passes. Now he will be struck with another remarkable physical fact, which experience has proved, and these statistics have developed—that fogs and gales, in certain parts of the lanes, seldom come together: for instance, as the fog-curves run up, the gale-curves, both for coming and going, come down, and *vice versâ*. This feature is very striking all the way from the meridian of 25° to that of 55°. These curves are both suggestive and instructive. Others have been added to show also the per cent. of calms, rains, and thunder and lightning, by each lane.

That you may judge also as to the relative frequency with which the parts of the ocean in which these two lanes are traversed by sailing-vessels, I have projected them also on series A of the Wind and Current Charts.

You will observe by referring to this series, that the part in which the lane going lies is very much frequented, but it is frequented mostly by vessels going. (See also Track Plate.) Those that are coming this way—that is, to the west—seek, for the most part, to avoid the Gulf Stream, either by going to the north, or by taking what is called the southern route, which is very common, especially in winter. So that steamers, when in the lane going to Europe, will find the vessels generally all bound the same way; and likewise, in the lane coming to America, the vessels seen, though not so many, will for the most part be steering to the westward. And when all are bound the same way, collisions are rare.

According to the tables given, the best routes for sailing-vessels to Europe, as there determined, run along, for the most part, south of the line going, until you reach the meridian of 45°, between which and 40° they cross this lane and run along between it and the other. These are the tracks that are projected on the plate appended.

I will close this report with a recapitulation as to distances and courses by each lane, between New York, Halifax, and Philadelphia on one side, and Cape Clear and the Scilly Isles on the other; first begging leave to say, that, according to my computation, founded on such statistics as I have touching the velocity of the Gulf Stream, if two steamers bound for Cape Clear, and of exactly equal speed, were to start from Halifax to see which should first get into the great circle part of the lane to Europe from New York, and if one were to go straight for it by steering east, and the other were to follow the European lane from Halifax as projected on the chart, this one would reach the point of destination quite as soon as the other, the drift of the Gulf Stream compensating for the greater distance.

DISTANCE BY LANE TO AMERICA.		By Great Circle.
From Scilly Isles to Halifax	2,351	2,305
,, ,, Capes of Delaware ...	2,948	2,909
,, ,, Sandy Hook	2,882	2,840
From Cape Clear to Halifax	2,192	2,170
,, ,, Capes of Delaware ...	2,789	2,765
,, ,, Sandy Hook	2,723	2,695
,, ,, Do. by actual average.		2,754

This statement shows that by the lane to America the distance is actually shorter, both to Sandy Hook and, we may infer also, to the Delaware, than the average distance by present route; for the route actually pursued by the steamers now, both to Sandy Hook and the Delaware, may be considered the same from Cape Clear or the Scilly Isles as far west as long. 70°.

DISTANCE BY LANE TO EUROPE.	To Scilly Isles.	To Cape Clear.
From Halifax	2,436	2,285
,, Capes of Delaware	3,024	2,873
,, Sandy Hook	2,980	2,829

Besides the detour from the great circle which a vessel from New York, Halifax, Boston, or Philadelphia would necessarily make by following the European lane to Cape Clear, it would require an *additional* detour of only 15 miles for vessels bound into the English Channel to use it also as far as Cape Clear. This lane, therefore, will, in consequence of the favourable currents of the Gulf Stream, put a vessel into Southampton quite as soon as she could reach that port from New York or Philadelphia by the great circle route. Vessels from Halifax will have to make the greatest detour of any by adopting the lane to Europe; but for them it is less than 100 miles out of their way as they now go, and it will prolong their average passage eastwards perhaps two or three hours. I say *perhaps*, because I am not sure but that the steamers from Halifax and New England are set back by the cold current 20 or 30 miles on the route now used for the eastern passage. The Gulf Stream, even from where they will join it by this lane, will not set them forward, on an average, 40 or 50 miles at the least. It seems, therefore, that the attractions of this lane as it regards safety should more than outweigh the *probable* loss of an hour or two during the passage. When I speak of distances by the lanes, it should be recollected that the *middle* of the lane is meant, as per following table of courses and distances :—

LANE TO AMERICA.

	Course.	Distance.
From Scilly Isles to Cape Clear,*	W. 33°.7′ N.	159 miles.
,, Cape Clear to lat. 51°.23′, long. 15°.0′	1°.55′ N.	187 ,,
,, lat. 51°.23′, long. 15°.0′ to lat. 51°.16′, long. 20°.0′	2°.17′ S.	187 ,,
,, ,, 51.16 ,, 20.0 ,, 50.56 ,, 25.0	6.5	189 ,,
,, ,, 50.50 ,, 25.0 ,, 50.23 ,, 30.0	9.50	193 ,,
,, ,, 50.23 ,, 30.0 ,, 49.36 ,, 35.0	13.41	199 ,,
,, ,, 49.36 ,, 35.0 ,, 48.33 ,, 40.0	17.45	207 ,,
,, ,, 48.33 ,, 40.0 ,, 47.15 ,, 45.0	21.8	216 ,,
,, ,, 47.15 ,, 45.0 ,, 45.38 ,, 50.0	25.10	228 ,,
,, ,, 45.38 ,, 50.0 ,, 45.0 ,, 51.45	27.13	83 ,,
,, ,,(*a.*)45.0 ,, 51.45 ,, 44.10 ,, 55.0	19.45	148 ,,
,, ,, 44.10 ,, 55.0 ,, 42.40 ,, 60.0	22.27	236 ,,
,, ,, 42.40 ,, 60.0 ,, 41.42 ,, 65.0	14.34	231 ,,
,, ,, 41.42 ,, 65.0 ,, 40.30 ,, 70.0	17.45	236 ,,
,, ,, 40.30 ,, 70.0 Sandy Hook,	0.43 S.	183 ,,
,, ,, 40.30 ,, 70.0 to Capes of Delaware,	W. 22.8 S.	249 ,,
,, ,,(*a.*)45.0 ,, 51.45 to Halifax,	3.53 S.	503 ,,

LANE TO EUROPE.

	Course.	Distance.
From Capes of Delaware to lat. 39°.40′, long. 70°.0′	E. 10°.46′ N.	230 miles.
,, Sandy Hook to lat. 39°.40′, long. 70°.0′	E. 14.29 S.	192 ,,
,, lat. 39°.40′, long. 70°.0′ to lat. 40°.31, long. 65°.0′	12.24 N.	237 ,,
,, ,, 40.31 ,, 05.0 ,, 41.9 ,, 60.0	9.39	227 ,,
,, ,, 41.09 ,, 60.0 ,, 41.33 ,, 55.0	6.5	225 ,,
,, ,, 41.33 ,, 55.0 ,, 41.53 ,, 50.0	4.57	232 ,,
,, ,,(*b.*)41.53 ,, 50.0 ,, 43.55 ,, 45.0	29.0	251 ,,
,, ,, 43.55 ,, 45.0 ,, 45.46 ,, 40.0	27.28	241 ,,
,, ,, 45.40 ,, 40.0 ,, 47.18 ,, 35.0	24.4	226 ,,
,, ,, 47.18 ,, 35.0 ,, 48.32 ., 30.0	20.18	212 ,,
,, ,, 48.32 ,, 30.0 ,, 49.30 ,, 25.0	10.21	206 ,,
,, ,, 49.30 ,, 25.0 ,, 50.14 ,, 20.0	12.46	199 ,,
,, ,, 50.14 ,, 20.0 ,, 50.45 ,, 15.0	9.17	102 ,,
,, ,, 50.45 ,, 15.0 to Capo Clear	E. 4.34 N.	189 ,,
,, Cape Clear to Scilly Isles	E. 27.39 S.	151 ,,
,,(*b.*)Halifax to lat. 43°.30′, long. 00°.0′	E. 20.7 S.	103 ,,
,, lat. 43°.30′, long. 60°.0′ to lat. 42°.30′, long. 55°.0′	15.17	181 ,,
,, ,, 42.30 ,, 55.0 ,, 41.53 ,, 50.0	9.28	225 ,,

* The courses and distances are for the *middle* of tho lanes. Seo Charts.

Thus, it appears that one lane will practically shorten the distance from Cape Clear to Sandy Hook and the Delaware by 30 miles, while the other prolongs the distance going to Europe 75 miles; which prolonged distance, when measured, not by safety, but *in time* alone, the Gulf Stream, better weather, and diminished frequency of fogs, will more than compensate for. In my judgment, these lanes, if properly followed, will make the average length of passage, as determined by the mean of all for the year, probably less each way, certainly not more than an hour or two longer than it now is. Individual passages coming will perhaps not be made so quickly as they have been; but, on the average, trips will be shortened.

The plate and chart (Plates xlii. and xliii.) will make the subject of this paper perfectly intelligible.

KNOWLES' PATENT SAW AND SAW MILLS.

ARRANGED FOR SAWING LOGS AND RE-SAWING BOARDS AND PLANKS.

(Illustrated by Plate xli:)

Mr. Knowles, in describing his invention, and calling our attention to its merits, writes: "In addition to the communications herewith submitted, it is thought important to illustrate some of the details of practice as found by myself and others in the use of my patent saw and saw-mill, and which are intended to guard against any misapprehension as to apparent difficulties consequent on the use of my inventions, and as compared with previous practice.

"The action of my saw in removing the materials operated on is much the same as in the mortising-chisel; and it is guarded in its action much as the plane-bit is by its stock.

"The saw teeth stand at about the same angle as does the usual plane-bit—say about 45°; and to fit them for actual use, it is necessary, with the new saw, first to join the cutting edge straight; this being done, they are to be filed behind and below their cutting points, say about an eighth of an inch, as shown in the accompanying drawing: this prepares the teeth to receive the set.

"The set is formed with a sharp recess made with a three-cornered file, but finished with a knife-edge file, ground on one side until it is quite sharp. I have found it well, even after this, to firmly secure the set in a strong iron vice, and by striking a hard and well-directed blow on a well-fitted chipping-chisel, will make the recess sharper than the file will leave it. The front or under edges of the teeth should be filed at right angles to the plane of the saw before applying the set.

"The set is then applied; and a slight blow from a hammer will spread each side of the teeth. The spread of the teeth should be more than the required set for use; this surplus is to be removed by a file secured in a piece of hard wood such depth as when passed along the side surface of the saw will leave the required projection. In this way, a side surface—at the points of the teeth—may be obtained of sufficient extent to admit of 'pointing up the teeth' three or four times before it becomes necessary again to apply the set.

"The saw cannot well be filed whilst in the gate. It does not require more than ten minutes of time to remove, file, and replace it ready for action. In fact, this operation has been performed with a saw, after its use during nine consecutive hours in hemlock logs, in the space of seven and one-half minutes.

"In practice it is found to require not more than one-half the time to keep the saw in order: cost of files, not more than two-thirds the usual amount.

"The 'guard-line' should be of such depth as the quality of lumber acted on will admit of: for white pine, about one-eighth of an inch; for hemlock, a little less; and for oak, not more than one-sixteenth of an inch.

"The sawer will determine the extent to which the 'guard' can be used by a little time in practice.

"The saw is not overhung, like the usual practice, but works perfectly vertical; and by the adjustibility of the 'pendulous ways,' each tooth is compelled to do an equal share of duty—the first as much as the last—throughout the entire stroke of the saw, regardless of the increase or diminution of feed.

"It will be observed that in setting the saw the teeth are not bent, but must range parallel to the plane of the saw. In joining the teeth on their cutting edges, and to bring them to a right angle to the sides of the saw, a file is fitted in a piece of hard wood edgewise, and at right angles to the piece. By keeping this stock fair against the side of the saw, the result of the action of the file will be mechanically correct, forming a guide for bringing the teeth to the proper cutting edge.

"Unlike other saws, each tooth contains *within itself* the requisite set for operation, *and one tooth alone* would cut a straight kerf. In consequence of this kind of set and 'guard-line' the teeth do not require bending; and thus presented to the material acted on in a direct line to the planes of the saw, they are vastly more capable of being crowded into the log, less liable to cut out of line, and more certain to cut the lumber smooth. The lower edges are not torn, as is the case with a large feed and the usual saw, but come from this saw with its *greatest* feed perfectly sharp.

"During all the tests, under the management of inexperienced persons, not one saw or tooth has been reported broken; and I have never known such an occurrence.

"Saws for re-sawing cut out less than one-eighth of an inch, and with these, clusters of nails have frequently been cut off, with a slight injury only of a few teeth just at their cutting edges. I am able to use saws much thinner than those of the usual kind; and the log-saw cuts out fully one-sixteenth less than others.

"The log-saw has cut off spikes three-eighths of an inch square, and but seven teeth were dulled, these being taken off at their points *only* down to the 'guard line.'

"Owing to the fact that this saw cuts like a chisel, there has been cut 1,200 feet of knotty pine and 400 feet of white wood—measuring one surface—without filing the saw in cutting this amount.

"The saws are manufactured at the same cost as other kinds. The iron parts of the mill, after leaving the main driving-shaft immediately belonging to the engine or motor, cost 25 per cent. less than any well-constructed upright log sawing mill.

"The wood or millwright work costs about the same as the ordinary plans. The power to drive this plan of log-mill, cutting two to one of the best of other plans, is fully one-third less.

"The limit of cut with my first feed arrangement was $3\frac{1}{4}$ inches; and this extent was cut each downward stroke, in pine logs upwards of 16 inches deep. The present arrangement of the feed is susceptible of upwards of five inches.

"Cutting five inches, and at the same time making good lumber, doubtless will appear beyond the possibility of accomplishment; and although this has not been done, yet from what has been accomplished with my former feed, together with finding that the *only* limit in the extent of cut has been the amount of chips the space between the saw-teeth were capable of holding, I am most positive, with these spaces enlarged, my mill and saw combined will cut five inches each cutting stroke, in lumber of from 12 to 16 inches in depth.

"I am enabled through the aid of the 'pendulous ways,' and the fact of not overhanging the saw, to use a long stroke, and to cut, as hereinbefore stated, with each tooth within range of the material contained within the stroke of the saw. I now use a stroke of 44 inches, and a saw, when the logs require it, of eight feet in length. It is contemplated soon to increase to four feet, and increase also the length of the saw to suit the circumstances.

"The certificate here appended shows that the *first* and experimental log-mills have cut double the amount of that of the best mills in use of the usual kind; and as a precautionary act in guarding against unfavourable contingencies, I hereby guarantee my log-mill, when combined with my saw, to cut 50 per cent. more, under equally good circumstances, than any mill for sawing logs now in use; and that the power to do this shall be 30 per cent. less than that of the usual mills cutting *fifty* per cent. less.

"The re-sawing-mill has split more than four to one of the amount cut by any other mill, as will be seen by the accompanying certificate; and I also guarantee it shall cut two to one, or double the amount in the same time, of equal quality of lumber any other mill is capable of cutting.

"Respectfully,
"HAZARD KNOWLES."

Certificate above referred to.

"Albany.

"In answer to inquiries, I would say that I have run one of Hazard Knowles' mills for Mr. Jones, of Albany, for the last four months, and find that I can easily average 10,000 feet per day, board measure.

"I have cut as high as 1,500 feet in one hour, and believe that 2,000 feet can be cut under favourable circumstances.

"The lumber cut is smooth, and better than that cut by the common saw.

"It takes some care and pains to keep it in order, but it is not as likely to run or dodge as the common saw.

"On the whole, I regard it a great improvement; and if well managed will cut from two to three times the amount of the ordinary mills.

"Respectfully, &c.,
"WILLIAM KELLOGG, *Millwright and Sawer.*"

[We are compelled, from the great pressure of important matter this month, notwithstanding our greatly increased size, to omit the description of this invention, with the references to Plate xli].

AMERICAN NOTES.—No. VI.

PERFORMANCE OF STEAM-TUG "LEVIATHAN."—In the February number, I gave you the particulars of this steamer. I have now to record one of her performances. She left this city for Portsmouth, N.H., distant by the shortest possible route 315 miles (knots), and returned from there with the semi-clipper ship *Dreadnought*, of 1,500 tons measurement, performing the entire distance of 630 miles, as measured on the chart by Lieut. M. F. Maury, of the National Observatory, in 57 hours and 58 minutes (say 60 hours), including her detention there in attaching the tow, &c. The average speed per hour is $\frac{630}{60} = 10{\cdot}5$ knots per hour.

VANDERBILT'S EUROPEAN LINE.—The steamer *North Star*, the first of this line, left here on Saturday last, the 21st April, direct for Havre; she will be followed by the *Ariel* on the 20th May, and after this these steamers are to leave here and Havre every three weeks. This is indicative of great confidence in the speed and endurance of these vessels: it is what the Collins steamers are now doing since the loss of the *Arctic*—that is, they leave every two weeks with three steamers, which is the same duty as for two steamers to leave every three weeks: added to this, Havre is a route of a day longer than hence to Liverpool. The new steamer of this line is commenced, and is rapidly progressing. Her dimensions, &c., will not vary essentially from the following:—

Length at load-line	320 feet.
Beam	45 „
Hold	31·6 „

Engines, two, vertical beam; cylinders, 85 inches in diameter; stroke of piston, 12 feet; water-wheels, 41 feet diameter; blades, 10½ feet in length.

The hull is building by J. Simonson, at Greenpoint; the engines, by the Allaire works. Mr. W. A. Lighthall, the well-known engineer, is the superintendent of her machinery.

NAUTILUS SUBMARINE COMPANY.—The enterprise undertaken in part by this Company, as detailed in my notes for February, will, as it appears by the following extract from a letter, in all probability prove eminently successful:—

The bark *Emily Banning*, Captain Fletcher, which left this port in December, with three of the Nautilus Submarine Company's machines on board, bound for a pearl-fishing voyage, is now engaged in exploring the wreck of the frigate *San Pedro*, on the coast of Venezuela. This frigate, supposed to have on board some two to three millions of dollars, took fire and blew up at the island of Margarita, in 1815. Her stern being blown out, her treasure was scattered upon the surrounding sand. Some three hundred thousand dollars have been taken up, but, owing to inefficiency of the machinery employed, operations were suspended. The Company fitting out the *Emily Banning* stopped there, and the trial descent of the first machine sent down in 66 feet water brought up one hundred dollars, thirty-two dollars being found within the first area covered by the machine before moving. Other articles, as copper, &c., were brought up at the same time. The captain, finding it profitable working, immediately left for the seat of government to secure the necessary privilege. This privilege was granted. Letters have been received from on board, during the absence of the captain, which represent the operators as busily engaged in "shovelling dollars." It is the intention of Mr. C. to blow the fragments of the ship to pieces, securing the copper guns, shot, &c. The captain writes—"The bells are all they are said to be." One of the chief engineers writes—"I wish you could look into the bell when we are down on the bottom, with our spades, digging for the almighty dollar. We can look out of the windows of the bell and see the fish looking in at us. We can take the bottom up in the bell, and get out on the sand, and pick up the bell and run all around where we like." Two months, it is anticipated, will be sufficient to take up every vestige of the *San Pedro*, and the captain reports he has another vessel near him, in same depth of water, 66 feet, with fifty thousand dollars on board, in specie, and another with fifteen thousand dollars, both of which he shall take up before proceeding on his voyage.

STEAM-BARQUE "ASTORIA."—Mr. William H. Webb, of this city, has just completed a propeller for the trade from San Francisco to Citta in the Pacific Ocean. She is built in the very best manner, and is deserving of notice from the circumstance that she is the first vessel completed in this country with the propeller fitted to hoist out.

DIMENSIONS, ETC., OF STEAM-PROPELLER "ASTORIA."

Hull by Wm. H. Webb, New York; Engines by Hogg and Delamata, ditto.

Length on deck from fore-part of stem to after-part of stern-post above the spar-deck	160 ft.
Breadth of beam at midship section (moulded)	25 „
Depth of hold	12 „
Tonnage	500 tons.

Description of engines, vertical direct; do. boiler, return flued. Diameter of cylinders, 26 inches; length of stroke, 2 feet 6 inches; diameter of screw (Griffiths'), 9 feet; pitch of do., 16 feet; number of blades, 2; 1 boiler; length of do., 22 feet; breadth of do., 8 feet 6 inches; height of do., exclusive of steam-chimney, 9 feet 6 inches; number of furnaces, 2; length of grate-bars, 6 feet 6 inches; number of lower flues, 10; internal diameter of upper do., 1 foot 7 inches; diameter of smoke-pipe, 3 feet; height of do., 24 feet; heating surface, 1,200 feet; combustion, natural draught; draught of water at load-line, 8 feet 6 inches; area of immersed midship section at this draught, 127 feet 6 inches. Floor-timbers at throats, moulded, 12·5 inches; do. do., sided, 8 inches; distance of frames apart at centres, 30 inches. Masts and rig, barque. Intended service, San Francisco to Citta. Description of coal, bituminous.

Remarks.—Floors are filled in solid; frame strapped with diagonal and double-laid iron braces, $3\frac{1}{2} \times \frac{5}{8}$ inch. Is fitted with a well for the hoisting out of propeller.

KRUPP'S CAST-STEEL AXLES AND TIRES.—Messrs. Thomas Prosser and Son, of this city, have become the agents for these articles; and from the several reports of the engineers and superintendents of various companies, it appears that these axles and tires are likely to be adopted, from their combinations of economy of wear, strength, and reduction of friction. The following report is a fair specimen of the results, after many experiments:—

Additional Report from the West Cornwall Railway Company, England.
Camborne, Feb. 23, 1855.

The cast-steel crank axle supplied by you continues in daily use, in excellent working order; and so far I am extremely well satisfied with it, both as regards workmanship, quality of metal, and work executed by it. It has run now near five thousand miles without any visible wear, and is in as good condition as when it arrived here. The workmanship and material of your tires are of the best quality, and I have no doubt of their efficiency.

Yours truly, (Signed) WILLIAM BRUNTON.
Resident Engineer.

LANES FOR STEAMERS CROSSING THE ATLANTIC.—Lieut. M. F. Maury, U. S. N., superintendent of the National Observatory, Washington, has furnished a full and instructing report, in reply to a letter from the underwriters, shipowners, and merchants of Boston, of 8th January last, asking him to propose one route for steamers in crossing the Atlantic to go, and another for them to come; their fellow-citizen, R. B. Forbes, Esq., having suggested such a mode as practicable. See p. 124.

New York. H.

THE CAPABILITY FOR MERCANTILE TRANSPORT SERVICE OF STEAM-SHIPS, WITH REFERENCE TO THE MUTUAL RELATIONS OF THEIR TONNAGE, DISPLACEMENT, ENGINE POWER, STEAMING SPEED, DISTANCE TO BE RUN WITHOUT RE-COALING, TONS WEIGHT OF CARGO, AND THE EXPENSE INCURRED PER TON OF CARGO CONVEYED.*

By CHARLES ATHERTON, M. Inst. C.E., Chief Engineer of H.M. Dockyard, Woolwich.

THE object of the following exposition on steam-shipping is to suggest and exemplify some definite process of investigation and arithmetical deduction whereby the capabilities for sea transport service of steam-ships may be as correctly estimated as is the capability for land transport service of the railway locomotive engine. Railway capability has already been reduced to a definite process of calculation, while steam-ship capability has never yet been subjected to arithmetical deduction, simply because the very terms "tonnage" and "horse-power," by which the elementary details of steam-ship service are designated, are absolutely indefinite. No legislative enactment has hitherto defined the standard unit of quantity that is meant by the tonnage of a ship, as denoting the measure of a ship's capability for transport service, either as respects measurement or weight, or what is meant by "nominal horse-power" as the standard unit of the measure of the amount of force which a marine engine may be legally required to be capable of exerting. Nevertheless, ships' *tonnage* and marine-engine *horse-power* are made the nominal base of mercantile pecuniary contracts to the extent of millions per annum. For example, in the Government transport service for the past year (1854), the amount of shipping employed has been designated as about 210,000 tons tonnage and 26,000 horse-power, involving pecuniary contracts based on the indefinite terms *tonnage* and *horse-power* to the amount of £3,000,000 sterling. In fact, it may be plainly asserted that a contract for the building or hiring of ships based simply on the nominal tonnage of the ship and the nominal horse-power of the engines binds the contracting parties as to the sum of money that is to be paid, without affording any definite or specific guarantee whatever as to the amount of capability for service that the vessels so purchased or hired will afford.

Such are the circumstances under which, in continuation of the public efforts that I have made since 1850, by publication and otherwise, to expose the anomalies of steam-shipping, I now respectfully call the attention of the Society of Arts to the subject of the capability for goods transport of steam-ships; and, considering that the Society of Arts is distinguished as the parent of no less than 350 Associated Institutions devoted to educational cultivation, and to the practical prosecution of all utilitarian pursuits in science and arts, I appeal to the Society, confident in the expectation that any effort to direct attention to the fundamental bases of steam-ship capability—namely, "tonnage" and "power"—as standard units of admeasurement, in such

* Paper read before the Royal Society of Arts, May 10, 1855.

manner as to construct thereon some system of transport £ s. d. *arithmetic*, will not fail of being countenanced by the Society, and promulgated for the consideration of its numerous associated correspondents, with a view to its being matured and rendered practically useful.

In the prosecution of this inquiry, the course which I propose to follow demands that I solicit the indulgence of the members of this Society, because, in the first place, I shall have to dwell on matters purely rudimentary, and the statistical character of the inquiry is suited rather for private study than for open dissertation; also, in the desire to be specific, repetitions will frequently occur. Thus, claiming your indulgence, I purpose to direct attention to the following points for consideration:—

1st. What is the builder's tonnage of a ship? What is the displacement of a ship? And, by reference to examples of steam-ship construction, to show that these two terms have practically no approximate ratio whatever to each other.

2nd. What is the nominal horse-power of a marine engine? What is the working power of a marine engine? And, by reference to examples of marine engine construction and practice, to show that these terms have no approximate ratio to each other.

3rd. To illustrate, by examples of steam-ship construction, the ratio of tonnage to nominal horse-power; which ratio is popularly regarded as expressing the efficiency of a steam-ship, as compared with the ratio of displacement to working horse-power, on which the locomotion of steam-ships is really dependent.

4th. To determine and define the measure of the unit of power which we assign to the term "horse-power," and also the unit of measure which we assign to the term "ton of displacement," as the fundamental basis of our calculations.

5th. To explain the law of resistance by which the motion of a ship is conventionally assumed to be affected, and enunciate the *rule* deduced therefrom, which may be regarded as sufficiently accurate to be practically available for calculating, approximately, the relation of displacement, power, and speed, in vessels of similar types of build, and for comparing the dynamic or locomotive capabilities of different types of build.

6th. To show the extent to which the coefficients of steam-ship efficiency, resulting from the rule above referred to, differ from each other, thereby exposing the difference of locomotive efficiency between one ship and another.

7th. Assuming any given type of form and any given size of ship, show the mutual relation of speed, distance, and cargo.

8th. To propose a system of arithmetical deduction whereby the cost of upholding and working steam-ships may be approximately calculated; and, by way of example, assuming a given type of build, and given size of ship, show the mutual relation of speed and £ s. d. prime-cost expenses incurred in the conveyance of goods on a given passage per ton weight of goods conveyed.

9th. To show the extent to which the cost of goods transport is affected by differences in the size of the ships employed, their coefficients of dynamic or locomotive duty and other constructive data being the same.

10th. Assuming a given type of build, show the extent to which the cost of goods transport is affected, according as it may be required to perform the whole passage direct without re-coaling, or to re-coal at certain intermediate stations.

11th. Show the extent to which the prime-cost expense of goods transport per ton weight is affected by differences in the dynamic quality of the ships employed, as measured by the difference of their coefficients of locomotive efficiency.

Recurring, now, to the foregoing divisions of our subject, taken in their order, it may be observed—

Firstly. The builder's tonnage of a ship, still usually adhered to, though now denominated as the old measurement, is determined as follows:—Rule. From the length of the ship (measured between the perpendiculars of stem and stern in feet) take three-fifths of the beam; multiply by the beam, and by half the beam, and divide by 94: the result is the builders' tonnage.

For example, take H.M. steam-vessels *Fairy* and *Bruiser*:—*Fairy*, length, 144 feet 8 inches; breadth, 21 feet 1½ inches; tonnage, 313. *Bruiser*, length, 160 feet 6 inches; breadth, 26 feet 6 inches; tonnage, 540.

It will thus be observed that the tonnage makes no specific reference either to the depth of hold or to the draught of a ship.

The displacement of a ship is the cubical measurement of the quantity of water displaced by the hull of the ship, and, when immersed down to to the constructor's deep-draught line, it is called the load displacement. The measurement is easily taken from the builder's drawing, showing the lines of the ship, and is dependent not only on the length, breadth, and draught of the ship, but also on the contour of the lines, whether it be full or sharp. The cubical measurement being thus ascertained, the weight of water displaced is readily deduced therefrom, at the rate of 36 cubic feet of water to the ton weight, which will be exactly equal to the weight of the floating mass. Occasionally, builders supply the owners of ships with a statement termed *Scale of Displacement*, showing the weight of the water displaced by the hull of the ship, and therefore the weight of the floating body and its load as it becomes gradually immersed down to the constructor's deep-draught line. For example: displacement of the *Fairy*, at the constructor's deep draught of 5 feet, is 176 tons weight; *Bruiser*, at 14 feet, is 1,013 tons weight. Hence, by again referring to the statement of tonnage, it appears that, in the *Fairy*, the ratio of tonnage to displacement is in the proportion of 313 to 176; that is, each 100 tons of tonnage, builder's measure, gives 56 tons weight of displacement; but, in the case of the *Bruiser*, the ratio of tonnage to displacement is in the proportion of 540 to 1,013; that is, each 100 tons of tonnage, builder's measure, gives 188 tons weight of displacement.

Thus, it appears that two ships on the respective types of the *Fairy* and the *Bruiser* may be of precisely the same builder's tonnage, say 1,000 tons; but the displacement of the one will be 560 tons, and of the other 1,880 tons; and supposing the weight of the respective ships and their machinery and equipment, when ready for cargo, to appropriate one-half of their respective displacements, the one ship will carry 280 tons of cargo only, while the other will carry 940 tons; that is, the one will carry only one-third the cargo of the other, though both ships are of the same builder's tonnage—viz., 1,000 tons. Hence, it appears that the builder's tonnage of ships affords no approximate indication whatever, either of the ship's displacement or of the tons weight of cargo that the ship will carry; and, in like manner, since no notice is taken of the depth of hold, the builder's tonnage affords no certain indication of the capacity of the ship for cargo. This latter defect is approximately corrected by the new measurement of tonnage; but still the new mode of measurement takes no cognisance of displacement, and, therefore, affords no guarantee of the tons weight the ship will carry when immersed down to the constructor's deep-draught line.

Secondly, as regards horse-power. The nominal horse-power of marine engines has hitherto been determined by a rule which originally may have duly represented the then general practice of steam-engine construction, and the rule was as follows:—

Assume the effective pressure on the piston at 7 lbs. per square inch, after making all deductions for imperfection of vacuum, friction, and other drawbacks; next, *assume* that the working speed of the piston is at a given rate, according to a certain specified and tabulated rate of speed dependent on the length of stroke; assume 33,000 lbs. raised 1 foot high per minute as the measure of the unit of power to be denoted by the term horse-power; then, multiply the area of the piston expressed in square inches by the assumed effective pressure on the piston (7 lbs.); and again, multiply by the speed assigned to the piston expressed in feet per minute according to the length of stroke: the product is assumed to give the total amount of moving power expressed in pounds raised 1 foot high per minute, which divide by 33,000, the result is the nominal horse-power. For example:—

H.M.S. *Terrible*, 4 cylinders, 72 inches diameter, 8 feet stroke, at 240 feet per minute, 829 nominal horse-power, called 800.

H.M.S. *Banshee*, 2 cylinders, 72¼ inches diameter, 5 feet stroke, at 210 feet per minute, 364 nominal horse-power, called 350.

H.M.S. *Elfin*, 2 cylinders, 26⅝ inches diameter, 2 feet 6 inches stroke, at 170 feet per minute, 40 nominal horse-power.

In calculating the nominal power of screw-propeller engines, it has become necessary to give the engines credit for the speed of piston actually attained instead of the tabular speed; but this practice is not enforced by any conventional rule, nor is it invariably adopted; and the distinction thus partially introduced between the paddle-wheel engines and screw-propeller engines only adds to the confusion. Hence, the nominal horse-power is based on assumption, not on fact; and by the only recognised rule for calculating power, no notice is taken of the boiler, on which everything depends.

The working horse-power, usually denominated the *indicated* horse-power (because ascertained by means of an instrument called the indicator), is measured as follows:—

Ascertain, by means of the indicator, the *actual* pressure of steam per square inch on one side of the piston, and the *actual* condition of the partial vacuum on the other side of the piston; these together will give the gross pressure per square inch exerted by the piston. Multiply the area of the piston expressed in inches by the *actual* gross pressure per square inch, and again multiply by the *actual* speed at which the piston moves, expressed in feet per minute, and divide by 33,000. The result is the gross indicated horse-power; and it has been laid down by some acknowledged authorities in such matters that the net effective power of an engine may, as a general rule, be expected to be 25 per cent. below the gross power; that is, if we divide the gross moving power by the divisor 44,000, instead of 33,000, the result will give approximately the net effective horse-power as given out by the engines. For example:—the following statement shows the nominal horse-power, the gross indicated horse-power, and the effective horse-power, of H.M. steam-ships *Trident*, *Retribution*, *Caradoc*, and *Elfin*, as follows, namely:—

Trident, nominal 350, gross indicated 492 ; effective, taken at 25 per cent. less than the gross indicated, 369.

Retribution, nominal 400, gross indicated, 1,012 ; effective, taken at 25 per cent. less than the gross indicated, 819.

Caradoc, nominal 350, gross indicated 1,600 ; effective, taken at 25 per cent. less than the gross indicated, 1,200.

Elfin, nominal 40, gross indicated 244 ; effective, taken at 25 per cent. less than the gross indicated, 183.

Hence, it appears that in the *Trident* the ratio of the nominal horse-power to the effective horse-power has been 350 to 369 ; that is, each 100 nominal horse-power has worked up to 105 effective horse-power.

In the case of the *Retribution*, the ratio of nominal horse-power to the effective horse-power has been 400 to 819 ; that is, each 100 nominal horse-power has worked up to 205 effective horse-power.

In the case of the *Caradoc*, the ratio of nominal horse-power to the effective horse-power has been 350 to 1,200 ; that is, each 100 nominal horse-power has worked up to 343 effective horse-power.

In the case of the *Elfin*, the ratio of nominal horse-power to the effective horse-power has been 40 to 183 ; that is, each 100 nominal horse-power has worked up to 457 effective horse-power.

Thus, it appears that four different sets of marine engines may be of the same nominal power, say 100 nominal horse-power ; but, nevertheless, their effective powers may be 105, 205, 343, and 457 ; that is, very nearly in proportion to the numbers 1, 2, 3, 4 : that is, the unit of nominal horse-power of the *Trident* is one-half that of the *Retribution*, one-third that of the *Caradoc*, and one-fourth that of the *Elfin*. In other words, the nominal power of a marine engine, though contracted for as a definite quantity, say 100 horse-power, affords no guarantee, not even approximately, of the effective power of the engines to be delivered under the contract.

Thirdly. Such being the anomalies as respects the nominal size of ships expressed by tonnage with reference to their really effective size expressed by displacement, and such being the anomalies as to the nominal power of marine engines with reference to their effective power, it is evident that the ratio of nominal horse-power to tonnage, which is usually quoted as expressing the mechanical efficiency of a steam-ship, is a delusion, in so far that both terms are mere fictions, affording no certain indication of the comparison between the means really employed—namely, the effective horse-power with reference to any definite unit, and the service really performed—namely, the displacement in tons weight actually moved at such speed as may be ; to illustrate which, I will refer to a few ships which are nominally powered very nearly alike, that is, in the ratio of about 100 tons of tonnage to 40 horse-power, or $2\frac{1}{2}$ tons of tonnage per nominal horse-power. For example :—

Vessels.	Builder's Tonnage.	Nominal Power.	Ratio of Builder's Tonnage to Nominal Power.
H.M. steam-ship *Encounter*	953	360	100 to 38
„ *Conflict*	1038	400	100 to 38
„ *Termagant*	1547	620	100 to 40
„ *Niger*	1072	400	100 to 38
„ *Sharpshooter*	503	200	100 to 40
„ *Undine*	290	110	100 to 38
„ *Fairy*	313	128	100 to 41
„ *Garland*	295	120	100 to 41
„ *Violet*	298	120	100 to 40
„ *Elfin*	98	40	100 to 41

Thus, the above-named vessels are nominally powered very nearly alike, namely, about 40 nominal horse-power to 100 tons of tonnage ; but in reality, as determined by their actual displacement and their measured working power, these same vessels are effectively powered as follows :—

Vessels.	Displacement. Tons weight.	Effective Horse-power, based on Indicator Measurement.	Ratio of Displacement to Effective Power.
Encounter	1482	505	100 to 34
Conflict	1628	583	100 to 35
Termagant	2312	988	100 to 43
Niger	1454	690	100 to 47
Sharpshooter	620	306	100 to 50
Undine	250	331	100 to 132
Fairy	177	273	100 to 154
Garland	250	376	100 to 182
Violet	250	434	100 to 177
Elfin	65	183	100 to 281

Hence, it appears that although the before-mentioned steam-ships are nominally powered alike, namely, in the ratio of 40 horse-power to 100 tons of builder's tonnage, and are officially rated as such, the absolute proportions of effective power to tons of displacement in these identical vessels actually fluctuate from 34 horse-power up to 280 horse-power for each 100 tons of displacement. Nevertheless, the locomotive efficiency of steamers is publicly recognised, even by the Board of Trade Mercantile Navy List, as being represented by the ratio of their tonnage to their nominal horse-power, and no cognisance whatever is taken of the displacement of ships at the constructor's load-line draught, or of the available effective power of the engines with reference to any definite unit of motive power. The delusion is recorded and published as fact; the truth is altogether disregarded. Is it possible that the service of steam-ships can be effectively conducted under such a system of uncertainty and delusion in regard to their respective capabilities ?

Fourthly. We now come to treat of the dynamic or locomotive operation of steam-ships; and since it is the engine-power that causes a steam-ship to move, and the tons weight of displacement moved at such rate of speed as may be, that constitutes the effect produced, it becomes utterly impossible to treat of and discuss the subject of steam-ship locomotion without defining, in the first place, what shall be the measure of the unit of power which we denominate as marine horse-power. We have already referred to the nominal horse-power as being calculated on assumed limitations, which are no longer recognised in marine-engine practice, and are therefore a mere fiction ; but we have referred to the gross indicated power as a reality, in so far that it is an actually measured quantity, based on the definite standard of 33,000 lbs. raised 1 foot high per minute ; and the gross measure, as exerted by the piston of an engine, has been, by tacit concurrence, converted into net or effective working power of the unit above referred to, by the assumption that friction and various other causes of detriment, not definitely measureable, may be fairly expected to obstruct the action of an engine to the extent of 25 per cent. ; that is, in order to obtain effective horse-power of the unit 33,000 lbs. raised 1 foot high per minute, the gross indicated force exerted by the piston, as measured by aid of the indicator, and described in pounds weight raised 1 foot per minute, must be divided by the divisor 44,000, in order to give effective horse-power of the unit 33,000 lbs. raised 1 foot high per minute. But even this measure of the effective unit of power of marine engines has been altogether superseded in modern marine-engine practice, and no definite measure has been, by common consent or by legal enactment, substituted in its place. For example, referring to an essay recently published by myself on Steam-ship Capability, page 5, it appears that the engines of ten steam-vessels lately employed by the Government as mail-packets—namely, *Banshee*, *Llewellyn*, *Caradoc*, *Vivid*, *Garland*, *Violet*, *Onyx*, *Princess Alice*, *Undine*, and *Elfin*—were contracted for and supplied to Government as amounting in the aggregate to 1,840 nominal horse-power ; but the measured gross indicated power capable of being exerted by these engines actually amounted to a power equivalent to 285,758,000 lbs. raised 1 foot per minute ; which divided by 1,840, gives 155,303 lbs. raised 1 foot high per minute, as the gross measure of the unit of marine horse-power thus actually delivered under the denomination, nominal horse-power. In consideration, however, that the contractor's supplied engines for the mail packet service exerting an amount of power undoubtedly above the ordinary practice of trade, and considering further that the working power exacted from these mail packets, on the occasions of the proof trials by which the efficiency of the engines was tested, may have been forced beyond the limits of ordinary work, I have allowed 15 per cent. for this excess, and assumed 132,000 lbs. raised 1 foot high per minute as the gross indicated measure of the unit of power which may be expected to constitute a marine horse-power, and on which I have based my calculations in the essay above referred to. It may, however, be observed, that the commercial result of such calculations is not affected by the measure of power that may be fixed upon as the standard unit of marine horse-power, whether it be 33,000 lbs. raised 1 foot high per minute, or 44,000 lbs., or 100,000 lbs., or 132,000 lbs., or 155,000 lbs., or any other number ; for, in proportion as the measure of the unit may be increased or diminished, so will the number of such units be the less or greater to perform a given service ; but, for the purposes of arithmetical calculation as to the comparative economy of different ships, it is evidently indispensable that *some definite measure of power be fixed upon as the unit of power*, and that the same measure of the unit be applied to all. In the following calculations, therefore, the unit of the gross marine horse-power as exerted by the piston of an engine will be regarded as equivalent to 132,000 lbs. raised 1 foot high per minute, and we shall regard the constructor's load-line displacement in tons weight, at the rate of 36 cubic feet of water to the ton, as expressing the size of a ship on which we base our calculations ; observing, however, that this measurement will not represent, or be any certain indication of, the entire capacity of the ship with reference to roomage for measurement goods. Equity requires that the builder be paid with reference to size or roomage, as one element of the building cost ; but science requires that the work performed by a steam-ship be ascertained with reference to the tons weight as measured by the ship's displacement, combined with the speed at which the ship may be propelled.

Fifthly. Our next step must be to determine the formula or "rule," whereby the law of resistance, as expressed by the mutual relations of displacement, power, and speed, in vessels of similar form, worked by engines of corresponding efficiency, may be most satisfactorily represented. The writer of this paper referring to the labours of others on this subject, and without impugning their conclusions, has been practically brought to the opinion that theoretical investigations in search of the form of vessel that shall give the greatest locomotive effect with a given amount of power, generally result in mathematical complications of too abstruse a character to be practically available, and that the theoretical deductions which may be thus arrived at would, after all, require experimental confirmation before being taken for granted. Our object is to determine what ships actually do, not what they theoretically ought to do. It is, therefore, presumed to be only by the result of actual experience, not of mere models of ships, but of ships themselves, that the type of form best adapted for locomotive duty will be ascertained. By adopting this principle of practical trial, though we may not arrive at perfection, we may obviate unheeded retrogression, which has hitherto been the bane of steam-ship constructive progress, and by taking the chance of occasionally getting a small step in advance of all previous types of build, we shall progress towards the attainment of perfection, at which it may never be said that we have absolutely arrived.

This course of procedure, however, evidently demands that we determine upon some standard rule whereby we may assign some definite number as the index number or coefficient indicative of the dynamic or locomotive efficiency of steam-ships, such coefficient being based on the data which the trial of the vessel may actually substantiate. Our object now is to fix the formula or "rule" by which this "coefficient" of locomotive duty shall be calculated. I believe it to be generally admitted that, for all practical purposes, though not strictly correct, the velocity (V) of a steam-vessel will vary as the cube root of the effective power, or as the cube root of the gross indicated power, provided that the effective and gross indicated powers be in a constant ratio to each other; or, in any given vessel the power will vary as the cube of the velocity (V^3) provided the displacement be constant, and friction evanescent. Also, if the speed be constant, the friction evanescent, and the types of form of the immersed hulls be perfectly similar to each other, though different in size or displacement, the resistance at any given speed, and the power to overcome that resistance, will vary as to the maximum cross section (A). Hence, for *similar types of form*, the friction being supposed to be evanescent, we have $\frac{V^3 \times A}{\text{H. P.}} = C$, C being some constant number for vessels of similar type of form, and of equal mechanical efficiency. But this formula is not adapted for calculations which involve the weights of the ship and cargo. We must, therefore, convert it into a form embracing displacement. Now, in similar types of form, the lengths, breadths, and draughts of one vessel will be in the same degree proportional to the length, breadth, and draught of another, and the maximum cross section (A) will vary as the square of either one of the analogous dimensions (a^2), whilst the whole cubical dimensions of the immersed hull or displacement (D) will vary as the cube of the same dimension (a^3), or a will vary as the cube root of D, and therefore a^2 will vary as $D^{\frac{2}{3}}$; but a^2 also varies as the maximum sectional area (A); consequently the maximum sectional area (A) varies as the cube root of the square of the displacement ($D^{\frac{2}{3}}$); consequently, for vessels of a similar type of form, propelled by engines of equal efficiency, $\frac{V^3 \times D^{\frac{2}{3}}}{\text{H. P.}}$ will be a constant number (C). If, however, the hulls be of dissimilar types of form, and the engines not equally efficient, the coefficient (C) will not necessarily remain constant; the different types of form and differences of external surface may affect the resistances in a different degree, and that type of form and engine adaptation thereto will be the best adapted for locomotive duty which, on actual trial of the ship, shall produce the highest coefficient, assuming that the engines be equally effective as respects the ratio of the gross indicated power to the net effective power, whereby the ship is actually propelled, and which may be tested by means of the dynamometer.

Hence, to test the locomotive efficiency of a steam-ship, let the vessel be tried by successive runs over a given distance; let the displacement of the hull at her trial draught be accurately measured; also, let the gross power as measured by means of the indicator, and the corresponding speed, either in knots or in statute miles per hour, be ascertained; then observe the following rule:—multiply the cube of the velocity (V^3) by the cube root of the square of the displacement ($D^{\frac{2}{3}}$), and divide by the gross horse-power: the result will be the numeral coefficient (C), which denotes the locomotive efficiency of the ship, or, in other words, the constructive merit of the type of form combined with engine adaptation thereto.

If the comparative efficiency of the engine department alone is to be determined, it may be effected approximately by working the engines at moorings, and ascertaining the ratio between the effective power as determined by the dynamometer and the gross power as determined by aid of the indicator, and at the same time taking the consumption of coal per hour with reference to the gross indicated power; and if the comparative efficiency of different types of form be required irrespective of the engine department, then the net effective horse-power must be determined by aid of the dynamometer, and substituted in the above mentioned formula for the gross indicated horse-power.

Sixthly. Assuming the rule—multiply the cube of the velocity (V^3) by the cube root of the square of the displacement ($D^{\frac{2}{3}}$), and divide by the horse-power (H.P.)—as producing a numeral coefficient or index number approximately indicative of the relative constructive merits of vessels as respects their types of form and engine adaptation thereto, I will now give a few examples of the application of the rule, showing the great difference that exists between one ship and another as respects their locomotive or dynamic efficiency; thence inferring the necessity which exists for such test trials of ships being more commonly had recourse to, as the most available means of *checking retrogression*, and duly maintaining in new ships our already realised advancement in the art of steam-ship construction:—

Names of Vessels.	Displacement. Tons Weight.	Gross Indicated Power. (Ind. H. P.)	Marine Horse-power. H. P.	Speed per Hour. Knots.	Index Number, or Coefficient of Locomotive Performance.
Candia	2520	1356	339	12	944
Rattler	1078	436	109	9.64	864
Fairy	168	364	91	13.32	792
Vulcan	2076	793	198	9.6	728
Arrogant	2444	623	156	8.3	664
Dauntless	2251	1218	304	10.29	616
Niger	1323	920	230	10.43	592
Conflict	1443	777	194	9.29	528
Termagant	2370	908	227	8.55	492
Dwarf	98	216	54	10.54	460

Thus, the coefficient of locomotive duty of the *Candia* (944) is about 30 per cent. superior to that of the *Vulcan* (728), and upwards of the double, or 100 per cent. superior to that of the *Dwarf* (460), though the engines of these three vessels were all made by the same manufacturer; the effect of which is, that, supposing two vessels of, say, 2,500 tons displacement, of the respective types of form and engine adaptation thereto of the *Candia* and the *Dwarf*, the former would be propelled at the speed of 10 knots per hour, by 196 marine horse-power of the unit 132,000lbs. raised one foot high per minute, while the latter would require 400 marine horse-power to be propelled at the same speed.

It must be observed that, in this great difference of locomotive efficiency between the *Candia* and the *Dwarf*, there are involved not only the known differences of type of ships' form and difference of engine efficiency, but also probable difference of resistance resulting from difference of friction from the immersed hull being possibly cleaner in one case than in the other; also possible differences of engine management, the one engine probably being screwed up or packed too tight, and the other running free. The difference of the coefficients in the cases referred to, shows that a positive malconstruction, or defective condition, or bad management, or abuse of some kind, exists to the extent of about 100 per cent.; and being thus proved to exist, the cause thereof should be inquired into, detected, and remedied, if remediable; or, possibly, it may be better to condemn an inferior ship, rather than run her at the disadvantage of incurring 100 per cent. extra expenses in the engine department of her service. (See Note at end of Paper.)

In mercantile steam-ship navigation, no method whatever of a definite description, such as that above described, has ever been adopted for testing the capability, condition, and management of steam-ships. The sacrifice of national interests, from vessels being ill-adapted for the most economical performance of the service required of them, is, probably, enormous, and, in my opinion, attributable to no specific quantities having been assigned to the terms *tonnage* and *horse-power* as standard unit measures applied to steam shipping. This deficiency in legislation requires correction, for, without such correction, inquisitorial arithmetic, as applied to steam navigation, can have no sound fundamental starting point; and the Society of Arts, more appropriately than any other, may undertake the task of effecting so desirable and so important a reform.

Seventhly. Presuming that the foregoing rule be admitted as representing, with sufficient accuracy for practical purposes, the mutual relations of displacement, power, and speed, in vessels of homologous construction, and that the numeral value of the coefficient or index number (C) be determined for a whole class of vessels of similar type by the actual test trials of any particular ship, we thus have the means of arithmetically developing the mutual relations of displacement, power, and speed, for all vessels of that constructive type; and I now proceed to develop, in the first place, the mutual relation of speed and power, assuming the size of the vessel at 1,500 tons displacement, and that, on test trial, the engines working at 240 horse-power, gave 12 knots per hour, whereby the coefficieut of locomotive efficiency would be 944, the unit of power being taken at 132,000 lbs. raised 1 foot high per minute. In this case, the horse-power required for propelling a vessel of 1,500 tons displacement at variations of speed from 6 knots per hour up to 20, would be as follows :—6 knots, 30 horse-power; 7 knots, 48; 8 knots, 71; 9 knots, 101; 10 knots, 139; 11 knots, 185; 12 knots, 240; 13 knots, 305; 14 knots, 381; 15 knots, 468; 16 knots, 569; 17 knots, 682; 18 knots, 809; 19 knots, 952; 20 knots, 1,110.

Thus it appears that to increase the speed of the ship 1 knot per hour from 8 knots to 9, requires that the power be increased from 71 to 101 horse-power, being an increase of 30 horse-power; but, to accelerate the speed 1 knot from 16 knots to 17, requires that the power be increased from 569 horse-power to 682 horse-power, being an increase of 113 horse-power, being four times the power required for the 1 knot increase from 8 knots to 9; and if we would double the speed of a steam-ship of given displacement, say from 8 knots to 16, we must increase the power from 71 horse-power to 569 horse-power, being 8 times the power; and as this increase of power must be effected without increasing the deep-draught displacement of the ship, the weight of remunerating cargo will be reduced by an amount equal to the increased weight of machinery, and the increased quantity of coal that will now be required for the passage on which the ships may be employed.

Further, in order to show the capabilities of this ship of 1,500 tons displacement on the type of the *Candia*, with reference to the conveyance of cargo on a given passage, say for 3,000 nautical miles without re-coaling, we must assign some definite limit to the weight of coal consumed per hour per horse-power; and since, in my own experience, I am not aware of any steam-ship service fitted with condensing marine-engines, as now generally in use, having been permanently prosecuted with a less consumption of fuel than at the rate of 4½ lbs. per indicated horse-power per hour, which is 18 lbs. per hour per marine horse-power of the unit 132,000 lbs. raised 1 foot high per minute, therefore, I assume the consumption of coal at that rate, also the weight of the machinery and engine equipment is taken at 5 cwts. per indicated horse-power, or 1 ton per marine horse-power of the unit 132,000 lbs. raised 1 foot high per minute, and the weight of the hull and its equipment complete, exclusive of the engine department, being supposed to appropriate 40 per cent. of the deep displacement, we have results as follow :—

If the vessel of 1,500 tons deep displacement be powered for steaming at 6 knots per hour, the passage of 3,000 nautical miles without re-coaling would require 125 tons of coal, and there would be 745 tons of displacement available for cargo; the weight of cargo in this case being 49 per cent. of the deep displacement.

But if the vessel be powered for 8 knots an hour, the consumption of coals would be 222 tons, and the cargo would be 607 tons; the weight of cargo in this case being 40 per cent. of the deep displacement.

If the vessel be powered for 10 knots per hour, the consumption of coal would be 347 tons, and the cargo would be 414 tons; the weight of cargo in this case being 28 per cent. of the deep displacement.

And if the vessel be powered for 12 knots per hour, the consumption of coal will be 500 tons, and the displacement available for cargo will be 160 tons; the weight of cargo in this case being only 11 per cent. of the deep displacement.

Hence, assuming steam-vessels, on the type of the *Candia* and other data, as specified, of 1,500 tons deep displacement, as the size of steamers employed upon a commercial transport service on a passage of 3,000 nautical miles, it appears that if the vessels be fitted for the speed of six knots per hour, the displacement available for cargo will be 49 per cent. of the deep displacement; at eight knots per hour the cargo will be 40 per cent. of the displacement; at ten knots per hour, the cargo will be 28 per cent. of the deep displacement; and at twelve knots per hour, the cargo will be only 11 per cent. of the deep displacement.

Eighthly. The foregoing statement exemplifies the mutual relation of speed and cargo, as respects the sacrifice of dead weight of cargo consequent on increasing the rate of speed; but at the same time that cargo is reduced by increased speed, the charges are increased, and, consequently, the commercial sacrifice consequent on increasing the rate of speed will be more comprehensively demonstrated if by any means we can form an approximate £ s. d. estimate of the prime-cost expenses that attend the steam conveyance of mercantile cargo per ton weight of cargo conveyed.

For the details of such an inquiry I may refer to pages 76 and 77 of the second edition of the Essay on Steam-ship Capability before referred to, whereby, including five per cent. per annum for interest on investment, ten per cent. per annum for upholding stock, and five per cent. per annum for insurance, the annual working charges in the ship department per ton of displacement (assuming the builder's tonnage and displacement to be equal) amounts to £6 11s. 2d., and the annual working charges of the engine department to £7 18s. per indicated horse-power, or £31 12s. per marine horse-power, exclusive of coals: the cost of coals being greatly dependent on the locality of the proposed service and state of the times, requires to be made a distinct item of charge; but for the purpose of exemplifying the proposed system of calculation, I assumed the cost of coal delivered on board ship at 40s. per ton.

For example, on this estimate, the annual prime-cost expenses attending the upholding and working a ship of 1,500 tons deep displacement, fitted with engines of 140 marine horse-power of the unit 132,000 lbs. raised 1 foot high per minute, will, exclusive of coal, amount in the engine department, to £4,424 per annum, and in the ship or hull department to £9,837 per annum, exclusive of coal, harbour, and other local dues, lights, and pilotage; and this annual charge against the ship of £9,837 for the ship department, and £4,424 for the engine department, is absolutely irrespective of the locomotive capability of the ship, or of the service that may be performed by the ship, and on which the earnings of the ship will be dependent. Now, in consideration that a steam-ship may be expected to be at sea only, say, 200 days per annum, and that it is only at sea that she does the service which must meet the total annual expenditure, it follows that in the ship department the outlay must be rated at 8d. per day, sea time, per ton of displacement, and the expenses in the engine department at 3s. per horse-power per day, sea time, exclusive of coals, which may be rated at 40s. per ton. For example: On these data, the prime-cost expenses per ton weight of cargo conveyed on a passage of 3,000 miles, by vessels of 1,500 tons deep displacement, fitted for the respective speeds of 6, 8, 10, and 12 knots per hour, and supposing them to be at sea 200 days per annum, and to be fully loaded both out and home, may be estimated as follows :—

Passage, 3,000 nautical miles; ship, 1,500 tons deep displacement; coefficient of locomotive efficiency that of the *Candia*, or $\frac{V^3 \times D^{\frac{2}{3}}}{H.P.} = 944$. Engine department rated at 3s. per horse-power per day, and coals at 40s. per ton. Shipping department rated at 8d. per ton of deep displacement per day.

Speed in Knots.	Horse-power.	Assumed Weight of: Hull.	Engine Department.	Total.	Time.	Coal.	Cargo.	Deep Displacement.	Items of Expense.	Expenses per Ton of Cargo. £ s. d.	£ s. d.
		Tons.	Tons.	Tons.	D. H.	Tons.	Tons.	Tons.			
6	30	600	30	630	20·20	125	745	1500	Coal	0 6 9	1 17 3
									Engine Department	0 2 6	
									Shipping Department	1 8 0	
8	71	600	71	671	15·15	222	607	1500	Coal	0 14 8	2 5 11
									Engine Department	0 5 6	
									Shipping Department	1 5 9	
10	139	600	139	739	12·12	347	414	1500	Coal	1 13 6	3 16 3
									Engine Department	0 12 7	
									Shipping Department	1 10 2	
12	240	600	240	840	10·10	500	160	1500	Coal	6 5 0	11 16 10
									Engine Department	2 6 10	
									Shipping Department	3 5 0	

From the above table we observe, that with vessels of 1,500 tons deep displacement employed on a passage of 3,000 nautical miles, the rates of prime-cost expenses per ton of goods consequent on steaming at the speeds of 6, 8, 10, and 12 knots per hour, will be £1 17s. 3d., £2 5s. 11d.,

£3 16s. 3d., and £11 16s. 10d.; which rates of prime-cost freight charge are nearly in proportion to the numbers 100, 120, 205, and 638. It is to be observed, that the total expense at 8 knots is about 20 per cent. in excess of the 6 knots speed, while the saving of time is 25 per cent.; consequently, it may be advisable that the steaming capability of steamers should be not less than 8 knots per hour. We must, however, be cautious how we exceed the speed of 8 knots per hour; for, at 10 knots, the prime-cost freight charges, under the circumstances of this case, become 70 per cent. in excess of the 8 knots speed; and, at 12 knots, the displacement available for cargo is so reduced that the prime-cost freight charges per ton of cargo become five times greater than the expenses incurred at 8 knots.

Ninthly. We may now usefully inquire into the effects that will be produced by increasing the size of the ship. Suppose, therefore, that we employ a ship of double the before-mentioned size, namely, 3,000 tons deep displacement, on the same 3,000 miles passage, and under the same conditions as to consumption of coal and other details of estimate, the results will be as follow:—

Passage, 3,000 nautical miles; ship, 3,000 tons deep displacement; coefficient of locomotive efficiency $\frac{V^3 D^{\frac{2}{3}}}{H.P.} = 944$.

Speed in Knots.	Horse-power.	Assumed Weight of: Hull.	Engine Department.	Total.	Time.	Coal.	Cargo.	Deep Displacement.	Items of Expense.	Expenses per Ton of Cargo: Items.	Total.
		Tons.	Tons.	Tons.	D. H.	Tons.	Tons.	Tons.		£ s. d.	£ s. d.
6	48	1200	48	1248	20·20	200	1552	3000	Coal	0 5 11	1 14 8
									Engines	0 1 11	
									Shipping	1 6 10	
8	113	1200	113	1313	15·15	353	1334	3000	Coal	0 10 7	1 18 0
									Engines	0 4 0	
									Shipping	1 3 5	
10	220	1200	220	1420	12·12	550	1030	3000	Coal	1 1 4	2 13 7
									Engines	0 8 0	
									Shipping	1 4 3	
12	381	1200	381	1581	10·10	794	625	3000	Coal	2 10 10	5 3 3
									Engines	0 19 1	
									Shipping	1 13 4	

From the above table we observe, that with vessels of 3,000 tons deep displacement (being the double of the size before referred to) employed on a passage of 3,000 nautical miles, the rates of prime-cost expenses per ton of goods, consequent on steaming at the speeds of 6, 8, 10, and 12 nautical miles per hour, as compared with the expenses incurred with the 1,500 tons ship, will be as follows, namely:—

£1 14s. 8d., £1 18s. 0d., £2 13s. 7d., and £5 3s. 3d., instead of £1 17s. 3d., £2 5s. 11d., £3 16s. 3d., and £11 16s. 10d., being a saving in favour of the large ship of 2s. 7d., 7s. 11d., £2 2s. 8d., and £6 13s. 7d. per ton of goods conveyed, or equivalent to 7 per cent., 17 per cent., 30 per cent., and 57 per cent., showing the advantage of the increased size according as the speed at which the service may be required to be performed shall be 6, 8, 10, or 12 knots per hour. Thus, we see the advantage of the larger ship in performing a *given service* under the *same conditions* of speed and distance to be run without re-coaling, provided that it be always fully loaded, and that its harbour services of loading and discharging cargo be performed with equal dispatch, and that neither mercantile, or local, or naval difficulties subject the larger ship to inconveniences not affecting the smaller.

Tenthly. On the other hand, however, let us suppose that the smaller ship of 1,500 tons avail itself of re-coaling at ports not accessible to the large ships of 3,000 tons, and that, instead of performing the whole passage of 3,000 nautical miles direct without re-coaling, it divides the passage into three stages of 1,000 miles each, re-coaling at the two intermediate stations. Under these conditions, the cost expenses per ton of goods conveyed the whole distance will be as follows:—

Passage, 3,000 nautical miles, performed in three stages of 1,000 miles each; ship, 1,500 tons deep displacement; coefficient = 944.

Speed in Knots.	Horse-power.	Assumed Weight of: Hull.	Engine Department.	Total.	Time per Stage.	Coal per Stage.	Cargo.	Deep Displacement.	Items of Expense.	Expense per Ton of Cargo: Items per Stage.	Total for Stage of 1,000 N. Miles.	Total for Passage of 3,000 N. Miles.
		Tons.	Tons.	Tons.	D. H.	Tons.	Tons.	Tons.		£ s. d.	£ s. d.	£ s. d.
6	30	600	30	630	6·23	42	828	1500	Coal	0 2 0	0 11 2	1 13 5
									Engines	0 0 9		
									Shipping	0 8 5		
8	71	600	71	671	5· 5	74	755	1500	Coal	0 3 11	0 12 3	1 16 10
									Engines	0 1 6		
									Shipping	0 6 10		
10	139	600	139	739	4· 4	116	645	1500	Coal	0 7 2	0 16 4	2 9 0
									Engines	0 2 8		
									Shipping	0 6 6		
12	240	600	240	840	3·11	167	493	1500	Coal	0 13 6	1 5 8	3 17 0
									Engines	0 5 1		
									Shipping	0 7 1		

Thus, by re-coaling at two intermediate stations, the cost expenses per ton of goods conveyed amount to £1 13s. 5d., £1 16s. 10d., £2 9s., and £3 17s., according as the speed is 6 knots per hour, 8, 10, or 12 knots, instead of £1 14s. 8d., £1 18s., £2 13s. 7d., and £5 3s. 3d., the expenses per ton of cargo incurred by the larger ship of 3,000 tons displacement, performing the passage of 3,000 miles direct, without re-coaling at any intermediate station. Thus, it appears the advantage resulting from the superior capability of ships of 3,000 tons displacement, over ships of half the size, namely, 1,500 tons displacement, on a passage of 3,000 miles, becomes altogether neutralised, and the scale turned in favour of the smaller ship, simply by her taking advantage of re-coaling at two intermediate ports, thus dividing the passage into three stages, instead of performing the 3,000 miles direct. In fact, it is the judicious adaptation of speed to the pecuniary rate of freight charges that the description of trade between any two ports will bear, and the judicious selection of the size of ships to be employed with reference to the amount of trade in both directions, and to the coaling stations which may be available, that constitute the very essence of steam-ship direction, on which steam-ship economy of transport is dependent.

On this point, namely, the relative dynamic or locomotive capabilities of large ships as compared with smaller, I am particularly anxious that I be not misunderstood before the Society of Arts: I do not only acknowledge, but I have also publicly endeavoured to demonstrate, the superior dynamic or locomotive capabilities of large ships for the performance of any given service under given conditions of steaming speed and distance to be steamed without re-coaling ; but what I would desire to inculcate is, that this mechanical, and, consequently, in a dynamic point of view, economic, advantage of large ships, may very soon become sacrificed, if, on the strength of magnitude alone we impose on the larger ship the obligation of steaming at a higher rate of speed combined with a greater distance without re-coaling, than we assign to the service of the smaller ship. My views as to the most available size of ships are professionally confined to the *mechanical* consideration of the case; I do not enter upon the mercantile and nautical questions by which, apart from engineering, the comparative advantages of large and smaller ships for any particular service are regulated and limited ; but, asserting as I do the superior capabilities of large ships in a dynamic point of view, I would also desire to point out the mechanical limitation of such superior capability, in order that the advantages attendant on size may be realised by vessels having such conditions of service only assigned to them as shall not exceed the limitations which they may be advantageously able to perform.

Eleventhly. The importance of subjecting steam-ship capability for transport service to the test of pecuniary arithmetical calculation, will be illustrated by our bringing into tabulated juxtaposition the £ s. d. prime-cost expenses that would be incurred by performing a given service, under given conditions, with vessels of given size (say 3,000 tons displacement), but of various locomotive qualities, as indicated by the differences of their dynamic coefficients. For this purpose, I have made a selection of ten different types of construction, whose dynamic coefficients have been determined by the actual test-trial performance of the respective ships, and calculating the £ s. d. prime-cost expenses per ton of goods conveyed by ships of these types of 3,000 tons displacement, on a passage of 3,000 miles, at the speed of eight knots per hour, the results are as follow:—

Passage, 3,000 nautical miles; displacement, 3,000 tons; speed, 8 knots per hour. (*The purpose of this table is to show the mutual relation between the dynamic coefficient and the £ s. d. cost of transport, the coal being rated at 40s. per ton, engines at 3s. per day per horse-power, and the shipping at 8d. per day per ton of displacement.*)

TYPE OF CONSTRUCTION.	Dynamic (C) Coefficient.	Speed.	Power.	Weight of Hull and Engines.	Time.	Coal.	Cargo.	Deep Displacement.	ITEMS OF EXPENSE.	Expenses per Ton of Cargo. Items. £	s.	d.	Total. £	s.	d.
		Knots.	Horses.	Tons.	D.H.	Tons.	Tons.	Tons.		£	s.	d.	£	s.	d.
Candia	944	8	113	1313	15·15	353	1334	3000	Coal	0	10	7			
									Engines	0	4	0	1	18	0
									Shipping	1	3	5			
Rattler	862	8	124	1324	15·15	387	1289	3000	Coal	0	12	0			
									Engines	0	4	6	2	0	9
									Shipping	1	4	3			
Vulcan	728	8	146	1346	15·15	456	1198	3000	Coal	0	15	3			
									Engines	0	5	9	2	7	1
									Shipping	1	6	1			
Arrogant	664	8	160	1360	15·15	500	1140	3000	Coal	0	17	7			
									Engines	0	6	7	2	11	7
									Shipping	1	7	5			
Dauntless	616	8	173	1373	15·15	541	1086	3000	Coal	0	19	11			
									Engines	0	7	6	2	16	2
									Shipping	1	8	9			
Hogue	602	8	177	1377	15·15	553	1070	3000	Coal	1	0	8			
									Engines	0	7	9	2	17	7
									Shipping	1	9	2			
Conflict	528	8	202	1402	15·15	631	967	3000	Coal	1	6	1			
									Engines	0	9	10	3	8	3
									Shipping	1	12	4			
Termagant	492	8	216	1416	15·15	675	909	3000	Coal	1	9	8			
									Engines	0	11	2	3	15	3
									Shipping	1	14	5			
Ajax	364	8	293	1493	15·15	916	591	3000	Coal	3	2	0			
									Engines	1	3	3	6	18	2
									Shipping	2	12	11			
Amphion	332	8	321	1521	15·15	1003	476	3000	Coal	4	4	3			
									Engines	1	11	7	9	1	6
									Shipping	3	5	8			

Thus, we see that as the dynamic coefficient varies from that of the type of the *Candia* (944) to that of the type of the *Amphion* (332), the prime-cost expenses of goods transport will increase from £1 18s. to £9 1s. 6d. per ton of goods conveyed on the service referred to. No doubt many causes may contribute to this great difference of dynamic or locomotive economy; but, whether the cause be inferiority of type of build, inferiority of engine adaptation, defective condition of hull or engines, bad management, or all of these causes of inefficiency combined, the result is equally detrimental to the commercial interests concerned in the service of the inferior vessel. And further, it is to be observed, that the economic advantages of a superior type of build may be sacrificed by an unnecessary weight of materials having been employed in the construction of the ship and engines, thereby encroaching upon the displacement otherwise available for cargo. Hence the advantage of knowing the displacement of a ship at her launching draught, and when fully equipped ready for cargo.

In the case of ships of war, the armament and personal and material equipment constitute a constant cargo, which may be called tons weight of "Naval Demonstration;" and it may possibly be said that the type of build of ships of war, with reference to their dynamic efficiency, is of secondary importance to their type of build, with reference to stability, sailing properties, capability for carrying guns at the bow and stern, and other essential naval requirements. Admitting the force of this argument, the question assumes the following form, namely:—In what naval respect are the types of form illustrated by the *Amphion* and the *Ajax* so superior to the types of the *Hogue* and the *Arrogant* as to compensate for the tons weight of "naval demonstration" in the types of the *Amphion* and the *Ajax*, being only 15 and 20 per cent. of the displacement of ships on those types of construction under the conditions of the assigned service, while the tons weight of "naval demonstration" afforded by the types of the *Hogue* and the *Arrogant* is 36 per cent. and 38 per cent. of their displacement under the same assigned conditions of service. And again, seeing that the types of the *Rattler* and the *Candia*, under the same assigned conditions of service, would carry "naval demonstration" amounting to 43 per cent. and 45 per cent. of their displacement, are we sure that the types of construction of the immersed hulls of the *Rattler* and the *Candia* do not admit of being approximately adopted as giving available immersed lines for ships of war? But further, embracing the £ s. d. consideration of the case, it may fairly be asked in what naval respects is the type of construction of the *Amphion* so superior to the type of the *Vulcan* as to make it practically worth while that the conveyance of "naval demonstration" on board the type of the *Amphion* on a passage of 15 days duration, at 8 knots per hour, should cost £9 1s. 6d. per ton weight, whilst its conveyance by the type of the *Vulcan* is only £2 7s. 1d. per ton weight? What superiority of naval efficiency have we to show for the difference of transport expenses per ton weight of "naval demonstration," which ships of these types under the conditions of service referred to would respectively involve?

In conclusion, it may be hoped that the discussion of these matters before the Society of Arts, and the truths which such discussion may elicit, will lead to public attention being directed to the necessity of legalising some system whereby the gross tons weight of displacement of ships at the constructor's specified deep-load immersion shall be ascertained; also, that the measure of the unit of power to be denoted by the term horse-power be defined and legalised; and that the records of the Board of Trade embrace the gross tons weight of displacement at the constructor's specified load-line draught, in addition to, and not to supersede, the present record of internal roomage, which latter system of admeasurement may doubtless be necessary for the purposes of fiscal regulation. It is respectfully submitted for the consideration of the Society of Arts, that without some legalised definition of the standard units of ships' measurement and of marine engine-power, by which steam-ships are hired, bought, and sold, and on which their capabilities are dependent, the transport service of steam-shipping cannot be subject to regulation, or even be brought within the pale of pecuniary arithmetical calculation.

Note.—As the consumption of coals is (*cæteris paribus*) proportional to the gross indicated H.P. actually worked up to, and as the speed is proportional to the distance divided by the time of passage, the locomotive performance of steam-ships may be comparatively tested by the following rule:—Divide the distance steamed (taken in nautical miles) by the steaming time (taken in hours), cube the quotient, multiply by the cube root of the square of the mid-passage displacement, and divide by the average 24 hours' consumption of coals expressed in cwts.; the result will be the index number, or coefficient, indicative of the locomotive performance of the steam-ship. By this rule, the economic operation of the boiler becomes included, and all reference to horse-power being obviated, the elements of this calculation are matters of ordinary counting-house record, and we thus obtain a mercantile rule, divested of engineering technicalities, for comparing the locomotive capabilities of steam-ships.

CALLEN AND RIPLEY'S "PATENT MULTIPLYING ROTATIVE MOTION," AS A SUBSTITUTE FOR TOOTH-GEAR FOR MULTIPLYING OR DIMINISHING SPEED.

It is true that "the wheel and pinion in various forms has, since the days of Archimedes, their inventor, held undisputed sway in the construction of all kinds of mechanism, although the want of an efficient substitute has been felt and acknowledged by practical men."

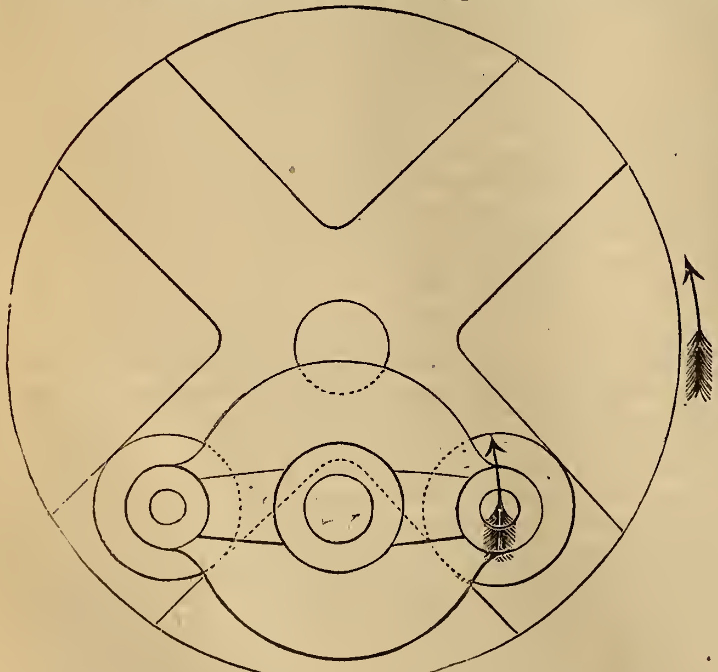


Fig. 1.

But recently a new construction of gear has been proposed and perfected under the above title (which is the subject of letters patent), combining, in a compact form, a new arrangement of parts, consisting of two rotating discs or frames, as will be seen on reference to Fig. 1, the one having grooves sunk on its face, and the other fitted with pins sheathed with rollers, by which the friction of the otherwise rubbing surfaces is avoided. Their action upon each other is precisely the same as the ordinary tooth-gear, with the same degree of uniformity of motion and force, but uniting with simplicity of construction, greatly

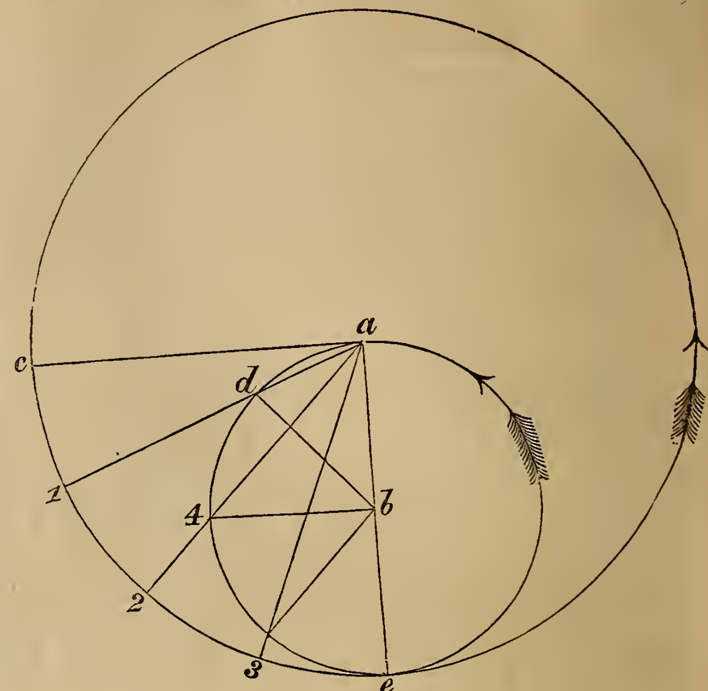
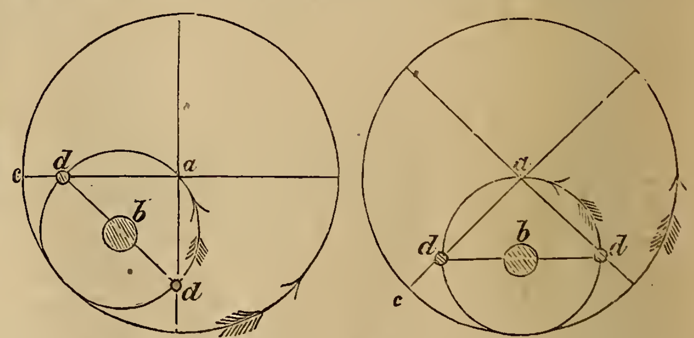


Fig. 2.

diminished friction, less liability to wear, greater freedom from accident, and a facility for restoring the parts most subject to deterioration.

The non-fulfilment of these conditions has proved fatal to the introduction of many ingenious contrivances for the same purpose; for, in consequence of the increased celerity with which most mechanical operations are now conducted, a failure in the agents would entail serious loss. The following simple illustration of a two to one movement will show that uniformity of motion is its distinctive character. In this figure will be recognised a familiar principle which has been applied as a substitute for the parallel motion in some of the early steam-engines, and also in an instrument for describing ellipses, called a trammel, having for its characteristic, that when the larger circle is stationary, and the smaller circle is made to rotate upon its own axis, the two circles being in constant contact, any point in the circumference of the latter will describe a straight line or diameter of the former.



Figs. 3 and 4.

In demonstration of the principle of action, let two circles be relatively placed, as in Fig. 2, and through the points *d* 4, 5, dividing the smaller circle into equal spaces, *a d*, *d* 4, 4 5, 5 *e*, let lines be drawn to the circumference of the larger circle, then will *c* 1, 1 2, 2 3, 3 *e*, be equal spaces. Now, let these two circles represent two discs, and be conceived to rotate upon their respective axes, *a*, *b*; also let a groove, *a*, *c*, be sunk in the surface of the larger disc, radiating from its centre to its circumference, and let a pin, *d*, project from a point in the circumference of the smaller disc, which, being inserted in the groove *a*, *c*, is, by the rotation of the larger disc, made to follow the orbit of the smaller circle, and while the pin is performing one-half of a rotation about the centre *b*, the point *c*, in the larger disc, will make a quarter of a rotation about its centre, *a*, the increments of the spaces passed over being equal, showing that the most perfect equality obtains in the motion of the two circles representing the orbits of rotation, which are denominated the pitch circles, or circles of contact of the two discs. Now, if four such grooves be applied to the larger disc, and two pins to the smaller disc, as in Figs. 3 and 4, a more perfect continuity of motion is obtained, and

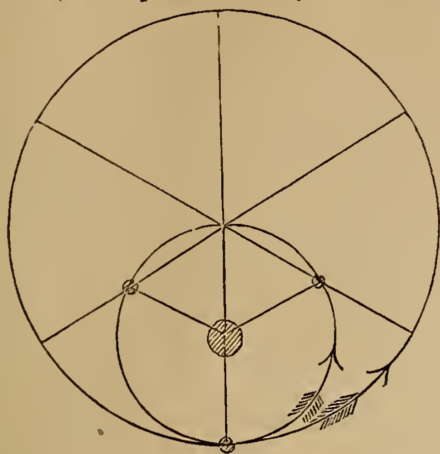
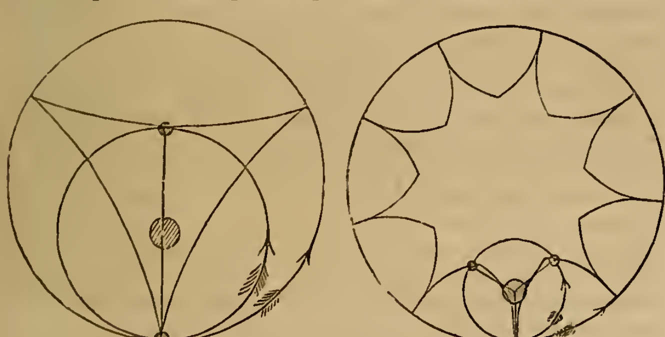


Fig. 5.

by the substitution of six grooves and three pins, as in Fig. 5, a still more perfect piece of mechanism is the result, and admirably suited for any operation where great nicety and perfectly noiseless action is desirable. The number of grooves and pins may be increased with advantage in the higher multiples, but it is scarcely necessary to exceed four pins in the smaller disc for any purpose, however delicate.

It is obvious that the ratio subsisting between the number of grooves in the larger disc, and the number of pins in the smaller disc, must be the multiple of their respective speeds. Thus, in a two to one motion,



Figs. 6 and 7.

with two pins, four grooves are required; with three pins, six grooves; and with four pins, eight grooves, and so on. So, in like manner, with a three to one motion; if three pins be used, nine grooves will be required; if four pins, twelve grooves, and so on.

One of the peculiar features of this arrangement is, that to obtain uniform motion in a two to one movement, the grooves on the face of the larger disc are straight, and pass directly through the centre of motion; but in all other multiples, whether less or more than two to one, they are curves traced by the intersection of the pins with the radius of the larger circle, as seen in Figs. 6 and 7, which represent multiples of one and a half and three to one respectively.

(To be continued.)

RAMBLES AMONG THE REAPERS.

By Robert Scott Burn.

(Continued from p. 106.)

On the 23rd of July, 1843, letters patent were granted to Charles Phillips, of Chipping Norton, "for improvements in apparatus or machinery for cutting corn, grass, or such like standing or growing crops, and an apparatus or machinery for cutting vegetable substances as food for cattle." The number of this patent is 9,812. The cutting apparatus of this machine consists of a series of small circular discs, the edges of which are sharpened. These discs are placed in pairs, the edge of one slightly overlapping that of the other. Each pair is inclined to its neighbour, so that the double pairs form, as it were, the letter A. One set of the discs receive the motion of the main driving-axle, by means of a series of cranks, attached at one end to a beam which is moved to and fro, and at the other to a stud placed in the upper face of the disc, eccentric to its main centre. A small toothed wheel is fixed in the centre shaft or stud of this disc, which takes into a toothed wheel on the shaft of the other disc, revolving in contact with it.

The date of the patent next in sequence is August 22nd, 1846 (No. 11,346). It was granted to Matthew Gibson, of Newcastle-upon-Tyne, "for a machine for reaping, cutting grass and other similar substances." In this machine, the cutting apparatus resembles very closely in form and appearance that of Smith of Deanston's. The cutters are formed of small knives or blades with curved ends, the convex edges being sharpened. These are attached to the under side of a conical circular frame, the smallest diameter being nearest the ground.

On October 14th, 1847, (No. 11,007,) letters patent were granted to Sir John Scott Lillie, of Fulham, "for improvements in machinery applicable to tillage, and for other agricultural purposes." In the reaping-machine under this patent, the corn is proposed to be cut by a series of scythes attached to an endless chain passing round two large pulleys, one of which is driven by a steam-engine. This latter is placed on a framework of considerable length, and which is drawn slowly across the field in a direction at right angles to the line of corn; the framework being guided in its path by ropes or chains, parallel to each other, stretched across the field. The scythes are placed horizontally, and, in their sweeping advance from left to right, cut the corn. No apparatus is described for gathering the corn so cut; if performed by manual labour, no little risk will be incurred by the attendants, placed as they must be in such close juxtaposition with the swiftly-speeding scythes.

A patent was granted on the 19th of December, 1849, (No. 12,907,) to the celebrated mechanician Joseph Whitworth, of Manchester, "for certain improvements in machinery or apparatus for cutting metals, and also improvements in machinery or apparatus applicable to agricultural and sanitary purposes." In the reaping-machine described in the specification, the cutting apparatus is formed of a bell-shaped circular frame, to the under side of which the blades are attached, forming a continuous cutting edge.

On December 7th, 1850, (No. 13,398,) a patent was granted to Richard Archibald Brooman, "for improvements in agricultural machines." This machine is that known as M'Cormick's American Reaper. The following is a short description of the machine, as exhibited at the Great Exhibition of 1851:—The framework is triangular in form, and runs upon a small broad-tired wheel. A platform, supported by a smaller wheel, is made towards the left or near side of the frame—the extent of this being about five by six feet. Projecting from the front edge of this platform are a series of tines, or spear-headed prongs, an equal distance being between each. The cutting apparatus is formed of a long thin steel blade, which extends across the front of the platform, and works under the tines above named. The cutting edge of the blade is either straight or zigzag—it is made scratched or notched. The length of blade is divided into sections corresponding to the number of tines; the half of the teeth in each section incline in opposite directions. The corn is brought up to the cutting blade by a revolving vane or reel, like that used in Bell's Reaper. The standing corn is turned inwards, on the off-side of the platform, by means of a guide; on the other side, another guide is placed for putting aside the corn which is not to be cut till the machine comes round again to that part of the field, while the standing crop is brought up to the blade to be cut. After being cut, the corn falls upon the platform, from whence it is delivered to the field in the form of bundles or sheaves, these being raked on the platform by an attendant carried along with the machine. The reaper is drawn, not pushed.

INSTITUTION OF CIVIL ENGINEERS.

April 3, 1855.

The discussion being renewed on Mr. R. A. Robinson's paper "On the Application of the Screw-propeller to the larger class of Sailing Vessels," was continued through the evening.

It was argued, that a vessel carrying 3,000 tons, besides machinery and coals, would require 1,000 H.P. (indicated) to obtain 8½ knots per hour, and even by that means could not save more than 7½ days in a voyage like that of the *Red Jacket*. Arguing from these premises, and demonstrating the position by a diagram showing the courses of various ships, it was contended that the commercial advantages of employing auxiliary steam-power on voyages to Australia were questionable, inasmuch as the small saving of time on the voyage could not command such an increase in the rate of freight as had been named.

The prevailing westerly winds and currents in the Southern Ocean might always be depended on, if a proper course was taken, as laid down in Lieutenant Maury's charts; and it was not improbable that, from a continuance of the same admirable observations as had served for the foundation of these charts, and the classification of the valuable documents said to exist in the archives of the Admiralty, such further information would be obtained as would eventually still shorten and render more certain the voyages of the sailing-clippers.

It was admitted that small auxiliary power would be very desirable for enabling clipper-ships to work into and out of port, and to make some way in what were called the "horse latitudes;" but the expectation of great advantage being derived on the Australian voyage was contended to be fallacious. These remarks were not meant to apply to auxiliary screw-clippers intended for other routes, but rather to enforce the position of its being always necessary to consider carefully the peculiarities of the intended station, and to adapt the power and means of propulsion to them. The question of the speeds of American vessels was again raised, and it was contended that the transcripts of the logs alluded to were correct, and did fairly represent the speed attained.

It was shown that the *Great Britain* having 14,000 yards of canvas in a suit of sails, exceeded in extent of sails any of the clipper-ships; and that although it had been predicted for her that she would be a very fast steamer, yet it was not supposed that she would attain the great speed under canvas which she had actually exhibited; it having been stated that she had run 17 knots per hour, whilst dragging her screw through the water. The peculiarities of the method of building American vessels were described, and instances given of the facility of repair of well-built vessels, as compared with some of the cheap rapidly-built ships that had been turned out for the California trade.

Reference was made to the forms introduced to the Institution by Captain Henderson in 1847, and again in 1853, with the object of obtaining the particulars of area of midship section, lines of displacement, power of engines, &c., which were now asked for from the Author of the paper, who had furnished all that could be obtained: it was suggested to members to supply these, in order to render the paper complete for reference.

It appeared to be shown, that neither the full-powered steamers, nor the large auxiliary-power sailing-ships, hitherto placed on the Australian route, had been commercially successful, and therefore a class of minimum-power auxiliary screw-propelled ships, fully rigged, was advocated, with the view of sailing at all times, should the wind serve, and only to employ their steam-power in calms and under favourable circumstances. When the sun was far north, the trade-wind ceased and calms commenced, in 15½° to 16° North latitude, and continued as far as 3° to 4° North, or over a space of nearly 700 miles, in the usual track of ships from the North to the South Atlantic. In the contrary season, with the sun far south, the trade-wind usually failed in about 6° North latitude; and thence to the Equator, or 2° South, constant calms prevailed over 400 to 500 miles; the ships only getting over that space by occasional squalls of short duration.

Now, it was in these positions that the minimum power was required; and by its judicious use it was very possible to save ten days on the Australian voyage, and make a corresponding profit.

As to the comparison of the lifting the screw of the *Dauntless* in a frame by thirty men in nine minutes, as compared with turning up that of the *Caroline*, upon a rule-joint in the dead-wood, with three men in three minutes, there could not be any question as to which was the best system for a trading vessel; and it was contended that the screw should remain always coupled to the driving shaft, to avoid the rattling and noise arising from having easy allowance for coupling.

As to American vessels coming to Great Britain, it was contended that it was beneficial for both shipbuilders and merchants that the American vessels should beat those of this country, as otherwise the desire of having immense cargoes carried in vessels of nominal small tonnage would do away with all scientific improvements in construction.

The Americans had moreover shown that something of cargo must be sacrificed to speed, and this country was much indebted to them for the lesson; as also for demonstrating the necessity for having the best practical seaman for the captain, and making it his interest to get as much out of the craft as her power and speed would give.

It was contended, that as far as it had been practicable to procure such information, the displacement and the immersed area of ships had been given in the paper, but there was great difficulty in obtaining such data correctly from the builders. The consumption of coal for the distance run was also stated, as far as was practicable; because this was recognised as the only true means of ascertaining the commercial value of auxiliary power. Nominal horse-power had been referred to more as a standard of first cost, than as affording any measure of the power really employed.

The general assumption was, that having engines of 200 H.P. (nominal) and with the expenditure of 350 tons of coals, a sailing clipper-ship, with an auxiliary screw-propeller, might save ten days on an average passage to China, or to Australia; supposing the steam only to be used in calms, and under circumstances to enable a maximum effect to be produced by a minimum expenditure of fuel; it being taken as proved, that a minimum-powered clipper-ship could not possibly be commercially successful, if overloaded with coals, or consuming such a quantity of fuel as had been required by the auxiliary-power ships hitherto in use.

Full credit was given to the charts of Lieut. Maury for pointing out the steady wind-course; but it was contended that even on that track, at certain periods, there were winds so light, that the best ships could not make more than two knots an hour.

It was maintained that the Author of the paper had not received any intimation of the construction of the *Royal Charter*, and that the fact of the adoption, by so eminent a firm as Messrs. Gibbs, Bright, and Co., of the dimensions of the ship, and the power of the engines, so exactly similar to those advocated by the Author, was the best proof of the soundness of his views.

It was contended that this commercial question was of great importance, but it would have been desirable that it should have been preceded by a paper on the forms and capabilities of screw-propellers. It was, however, suggested that such a communication should still be made, when the whole question would be reopened, and the experience of the relative merits of the various systems of lifting the screws, and the results of dragging them through the water, could be fairly laid before the meeting.

Doubts were expressed as to the anticipated advantages of having a very small engine merely to give a slow speed to the screw when the vessel was under sail, and calculations were given to demonstrate its inutility, based on the results obtained by Messrs. Maudslay and Field in their experiments on the feathering screw.

The benefits arising from the friendly rivalry between America and Great Britain in shipbuilding, in engineering, and in general manufacturing and production, were frankly admitted, and fervent hopes were expressed; for that being the only kind of rivalry the two countries would ever be engaged in, it was the only contest in which the least successful was the greatest gainer.

March 2, 1855.

On Steam and Sailing Colliers.

The discussion being renewed on Mr. Allen's paper "On Steam and Sailing Colliers," it was contended, in spite of counter-assertions, that not more than ten voyages per annum were generally made by the large class of sailing-colliers, a few vessels only having reached twelve or fifteen voyages. The advantages of small engine-power for unloading these vessels had not been overlooked; but in the tables of comparative cost, it had been presumed, that whippers would be used in both cases, and thus no undue reduction had been shown in favour of the screw-colliers.

The want of success of the *Hunwich* was stated probably to have arisen from her being too small, and it was now submitted, that screw-colliers should not be less than 600 tons burthen. The actual cost of "filling and discharging" by steam-power in London was stated to be 5d. per ton, exclusive of any consideration of wear-and-tear, and of interest on the first cost of the engine. In the paper the saving had been taken at 6d. per ton when discharging by steam, as that would be presumed to include allowance for time gained by greater promptitnde. The average freight taken in the paper had been 8s. per ton, instead of 9s. 4½d., as stated in the discussion; this would account, in part, for the apparent discrepancy in the results, and the rest would be supplied by some difference as to the victualling, and a lower rate of insurance, by which the stated profit was increased.

It was contended, that the advantages of the system of bag-ballast had been admitted by all the practical seamen who had used it, and their testimony was very disinterested and reliable. The case of the *Temperance*, trading between Maryport and Belfast, was specially mentioned, as having been enabled to make three voyages more, within a given time, than could have been accomplished with ordinary ballast; the saving of time in ballasting and emptying was also considerable; and the entire cost of the bags, &c., was saved in less than one year and a half, and in that time there was not any appearance of wear in the bags. The fact of the captain being part owner might, from the extra care bestowed, account in some degree for this durability. The term of three years for steamers, and six years for sailing-colliers, might be taken as a fair average duration for the bag-ballast.

Particulars were given of the construction and voyages of the *Northumberland* steam-collier: her registered tonnage was 438 tons; she made 33 voyages in twelve months, delivering 20,033 tons of coal; the average direct distance per single voyage was equal to 344 miles; and the speed might be taken at 7·08 miles per hour, which was generally admitted to be the greatest speed at which coal could be advantageously conveyed.

It was stated, that in the *John Bowes*, a double bottom of iron was first tried,—then a ceiling of timber was substituted; but both were found to leak: bag-ballast was then substituted, but it did not answer in an economical point of view. Subsequently, flat iron tanks, running from stem to stern, had been tried successfully; and if they were large enough to permit access inside, and so placed as to allow them to be examined and painted externally, they would prove very durable. Side tanks had been also tried in the *John Bowes;* but they were found to be liable to strain the ship. The arguments against hold-ballast, as causing great waste and breakage of the coal in loading, were forcibly reiterated. It was stated, that the average cost of conveying coal to London by steam-colliers, if well managed, did not exceed 4s. per ton.

Some prejudice existed in the north against screw-colliers, because they caused some trouble in the harbours, by the rapidity of their movements, and their diverging from the usual routine; but where hydraulic or steam-power was used, with double gangs of whippers, and new dock facilities were afforded, there could be no doubt of the ultimate success of the system.

The calculation of the cost of tank-ballast was verified, and, from the experience of seven ships, was shown not to exceed £4 per ton of ballast, including all connecting-pipes, &c.

It was shown, that the alleged disadvantage of the double-bottom not affording free access for painting and repair, did not exist, as in order to hold a sufficient quantity of water for ballast, the space must be from 2½ feet to 3 feet deep, which was fully sufficient for all purposes of access. There could be no doubt of the system adding considerably to the strength of the ship. The extra cost of thus providing for 160 tons of ballast did not exceed £320.

It was contended, that the discussion had hardly done justice either to the importance of the subject, or to the paper, which possessed very considerable merit; it contained very useful information and careful calculations, and when it was reduced within readable limits, would be a valuable document, and great credit was due to the author for its production.

It was to be regretted, that the main question, of the extent to which steam-power could be economically substituted for sailing-colliers, had not been fully eliminated in the discussion. The figures on both sides had no doubt been honestly stated, and, as far as the experience of a limited period went, conclusions might be drawn; but the mere cost did not constitute the entire question, the regularity of the supply of the Metropolis was equally important; if that could be insured, the fluctuations in the price of coal would, to a great extent, be obviated. Under the present arrangement, the sailing-colliers were frequently wind-bound, and then arrived in such immense fleets as to derange all the provisions of the trade; casual speculators were enabled to gamble; whilst the regular merchants and coal-owners received no benefit, and the legitimate interests of the trade suffered. The working-colliers, the seamen, and the coal-whippers, all participated in the suffering, being alternately starved, by want of employment, and then having their strength and endurance taxed beyond their natural power. It was only when the supply of the Metropolis was conducted by screw-colliers, that these irregularities would cease, and the price of coal would be kept at a uniform rate throughout the year.

The abstract of the preceding discussion had omitted any notice of a discursive speech, describing chiefly the aspect of screw-colliers when viewed, under peculiarly pleasant circumstances, from Greenwich and Blackwall. It was to be regretted that the time had not rather been occupied in giving more positive information as to requisites in the construction of screw-colliers, and in giving the results of the experience of the failures, which almost inevitably occurred in the commencement of every great innovation. A paper of that nature would be a very valuable document. It was evident that much improvement still remained to be effected, not only in the construction of the vessels, the machinery, the mode of ballasting, and the system of loading, unloading, and working, but also in fixing the most remunerative rate of speed; there could be no donbt of the expense, and wear-and-tear, being in the ratio of the speed attained. It was generally thought by good authorities, that only as much steam-power as would attain 7 or 8 knots per hour was reqnisite, and it was a question, whether even a lower rate of speed, say about 5 knots, would not be more economical.

(Some observations were made with respect to the use of auxiliary steam-power; but as they were more analogous to the paper "On Clipper Ships," by Mr. Robinson, they are transferred to the discussiou on that paper.)

One of the most important practical points was the selection of competent commanders for steam-colliers, or, rather, the education of a special class of mariners and of engineers, for the purpose of accomplishing the voyages rapidly and economically: perhaps very few seamen yet understood all the peculiarities of the steam-colliers, and time would be requisite for ascertaining them.

It was further observed, with regard to tank-ballast, that no available space was occupied by the empty tanks, as the large screw-colliers were, from the great specific gravity of coal as a cargo, rarely quite filled, lest they should be too deeply laden for safety during a sea voyage.

In closing the discussion, a warm eulogium was passed on Mr. Allen's paper, both with respect to the facts narrated, and the industry and care exhibited in their collection. The contest now in progress between wind and steam was most interesting; and though it might be premature to form any decided opinion, from such short experience of the effect of the application of steam-power to colliers, yet enough appeared to be known to induce sanguine expectations of ultimate commercial success. It was not at all astonishing that great difference of opinion as to cost had been expressed, each speaker only giving the result of his own experience. Viewiug the question as one of steam *versus* manual labour, the ultimate result might be confidently anticipated. The united exertions, and cost of wages, &c., of the crews of six sailing-colliers, were stated only to effect as much work as the crew and steam-power of one screw-collier. Wherever similar struggles had occurred, success had invariably attended on steam. The questions of larger capital invested, greater wear-and-tear, &c., entered into the commercial considerations, and hinging upon them also, were those of a slower speed than 7 or 8 knots, and the advantages of regularity of supply for the metropolitan market—the latter being the most important consideration. The question of expenditure of fuel, for the purpose of attaining great speeds, rather regarded voyages in those regions where coal cost £2 to £3 per ton, than the voyage from Newcastle to London; on the latter route it was the alternative of expenditure of fuel and wear-and-tear of ship and machinery against a saving of time and of wages of the crew.

As to the question of the relative merits of the various kinds of ballast, it appeared, that whether by the double-bottom, or by tanks, it was most advisable to spread the water-ballast over the entire floor of the vessel. Now, a ship at sea should be considered as a beam; viewing it in that light, it was easy to perceive the difficulty in keeping the double-bottom water-tight. A beam required a top as well as a bottom, the upper part being in compression and the lower part in tension. So, also, a vessel: and until more care was devoted to the formation and staying of the deck, and to connecting it adequately with the sides and the bottom, the construction of vessels would be imperfect. It was not an uncommon occurrence to find the seams opening, and even the deck parting from the sides, when vessels got into heavy seas; hence the cabins became uninhabitable, and this, no doubt, also occasioned the leakage of the ceiling of the double-bottom. The only remedy would be to attach all the parts together, until the entire hull of a vessel became a beam. An iron deck, planked over, would, in a great measure, produce this result. It appeared to be injurious to a vessel to place such a weight amidships as was contemplated in the use of hold-ballast, and there was some danger of a vessel being rendered crank, and being strained, when encountering heavy seas.

The subject was as full of interest for nautical men as for engineers; and a hope was expressed, that in the course of ensuing sessions the results of longer experience would be laid before the Institution.

April 24, 1855.

The Paper read was—

On the Economic Distribution of Material in the Sides, or Vertical Portion, of Wrought-Iron Beams,

By Mr. J. Barton, M. Inst. C.E.

It was stated, that in the various investigations upon wrought-iron beams which had been submitted to the profession, comparatively little attention had been given to the part which the vertical portion of the beam had to perform, or to the elimination of the laws governing the strains in the sides, or the mode by which, on the application of a weight at one point of the vertical portion, the strain was resolved into a variety of strains, of known direction and intensity, in the top and bottom webs.

The systems of construction most generally used were shown to be the tubular or plate beam, the "Warren" girder, and the lattice-bridge; the latter being the least represented on a large scale until the recent construction of the Boyne Viaduct.

An investigation was then made of the direction of the strains in plate-beams, with and without vertical stiffening pieces, with the object of showing, that the only supposition which could give true results as to the horizontal strains in the top and bottom, was that the strains were diagonal through the vertical portion, and alternately tensile and compressive. This view was sustained by quotations from Mr. E. Clark's work on the Conway and Britannia Bridges, and from the experiments on the model tube, where the undulations in the sides showed diagonal strains, at an angle of about 45°, crossing each other at right angles. The calculation of "Warren's" girders by Mr. C. H. Wild was then alluded to, and the mode of calculating the strains in the bars of lattice-beams was investigated in detail, and a formula was given, deduced by the Author, for arriving at correct results, either for a fixed uniform load, for a passing load, or for the ordinary case in practice—a load partly constant and partly passing; the formula giving the maximum strains of compression and tension, in each case, to which each bar was liable.

A comparison was then entered into of the three systems. 1st, as to the amount of material required under each; and 2ndly, as to the comparative practical advantages of construction in each case. The amount of material theoretically required in each of the three systems was shown by diagrams, in which, by a geometric representation, the area of material was given, and the results arrived at appeared to be, that if the material in a theoretically perfect plate-beam was represented by 100, the "Warren" girder would only require 73, and the lattice 67; or, in other words, that the lattice saved 33 per cent. of material as compared to that of the plate or tubular beam, and the "Warren" saved 27 per cent.; the lattice requiring 6 per cent. less than the "Warren," chiefly from the fact of the angle of 45° being employed instead of 60° in the inclination of the bracing. It was argued, also, that, in the above consideration, the tubular-girder was placed in too favourable a position, taking into account the position assumed by Professor Haupt, in a paper before the American Institute in July, 1853, where it was asserted, that a plate could not theoretically act, within a large percentage, to the same advantage as a bar, for tension, in the side of a beam, between vertical stiffeners.

Among the practical considerations, the price per ton was stated to be in favour of the lattice-beam. The facilities which each system gave for so arranging the parts in compression that they would resist flexure, were examined, and an explanation was given of a mode, devised and adopted by the Author in the Boyne and other bridges, by which the struts themselves became lattice-beams, instead of mere bars, so that great rigidity was obtained. The presumed loss of strength from rivetting together the lattice-work was shown not to exist, as it was in no way more rivetted per ton than the plate-beam, and also as, by means of a mode of rivetting devised by the Author, the loss of area need never exceed one small rivet at any junction of two bars or plates.

The facilities for repairs and painting, and the small surface exposed to storms, were assumed as additional advantages in favour of the lattice system.

On these grounds, the author contended, that intersecting systems of bracing, set at an angle of 45° to the horizon, formed the most economic mode of constructing the sides of wrought-iron beams, and that both theoretical and practical considerations pointed to this conclusion. But whilst urging the subject on the attentive consideration of the profession, he felt bound to acknowledge, that it was only from the advanced ground already occupied by those who had investigated the question of the tubular and the "Warren" girders, that he endeavoured to go somewhat forward in the present investigation.

In an appendix to the paper, an account was given of the principal features of the Boyne Viaduct, at Drogheda, on the line of the Dublin and Belfast Railway, a work of about one-third of a mile in length, composed of twelve arches of blue limestone, of 61 feet span each, on the south bank, and of three similar arches on the north bank, resting on slender piers, the tideway being crossed by three lattice-beams, a centre span of 264 feet, and two side spans of 138 feet 8 inches each, in the clear, at a height of 90 feet above high water of spring tides. These lattice-girders, forming a continuous beam throughout their entire and combined length, were 22 feet 6 inches deep, the intersections of the lattice-bars at an angle of 45° forming squares of 7 feet 5 inches diagonally. The tension bars in the lattice were severally proportioned to the strain to which they were liable, whilst those which acted as struts were in themselves lattice-beams, made after the experience derived from a series of trials on the compressive force that might safely be applied, and of which the details were given. The sectional area of the piles of plates forming the top and bottom webs of the centre span was 113·5 inches at the centre of the top, and 127 inches in the bottom; over the piers towards the side spans it was 132·6 inches on the top, and 127 inches in the bottom; at the point of inflection, 45 feet from the piers towards the centre, the area both in the top and in the bottom was only 68·5 inches; and in the side spans the areas diminished to 41·3 inches at 80 feet from the piers, continuing thence with a uniform area to the abutments.

The roadway was 24 feet 6 inches wide, supported by transverse lattice-beams, laid at the level of the underside of the main-beams, and formed of Memel planking, 6 inches thick, carrying two lines of rails, a third temporary line being laid for the purposes of testing. The side spans were first tried, by loading them, simultaneously, with three trains of loaded waggons, weighing 280 tons on each span, or two tons on each running foot; under this load the greatest deflection was seven-tenths of an inch, whilst the middle of the centre span rose half an inch.

One of the side spans was then cleared, the other retaining its imposed weight; and the centre span was loaded with 540 tons,—rather more than two tons per running foot. In this condition, the deflection of the loaded side span was three-tenths of an inch, and that of the centre span was nearly 1 inch and seven-tenths, whilst the unloaded side-beam rose about three-tenths of an inch.

On the other side-beam being also unloaded—the weight of 540 tons still remaining on the centre beam—the deflection increased to 1 inch and nine-tenths, and both the side spans rose about three-tenths of an inch above their normal level.

When all the three spans were loaded with a weight of 1,100 tons—equal to 2 tons per running foot—the deflection in the centre span was 1½ inch, and that in the side spans was three-tenths of an inch. On the removal of this weight, the permanent set given to the beams was less than one-tenth of an inch.

The three spans had been calculated to bear a pressure of 5,500 tons spread over them, or about five times the weight under which they were tested, whilst the ordinary duty of the bridge could scarcely bring upon it more than 350 tons,—less than one-third of the testing weight, and about one-fifteenth of the load that it was calculated to bear. Under a load of 5,500 tons, there would be 15 tons per inch of tensible, and 13½ tons per inch of compressive strain.

The weight of wrought-iron was, in the centre span, 361 tons, and in the two side spans 151 tons each,—in the pillars over the piers 76 tons,—total weight, 739 tons of wrought-iron, besides 15 tons of cast-iron in the plates, rollers, &c.

The dimensions of the ironwork were such, that the greatest strain, under a maximum load, should not exceed a tension of five tons per square inch of sectional area, after deduction of the rivet holes, and less than 4½ tons per inch for compression.

The centre span was constructed with a camber of nearly 4 inches, and, on being relieved of its supports, it descended with its own weight only 1⅝ inch, but rose again ⅛th of an inch on the supports of the side spans being removed.

In order to demonstrate the accuracy of correspondence between the calculated position of the points of inflection and the actual situation practically, all the rivets in the top web, above that spot, were cut out, drifts being inserted *seriatim* during the process, and gradually taken out again, after marking the edges of the plates. After removing these drifts, the joints were made to close and to open by raising or lowering the side spans, demonstrating clearly that the points of inflection for a uniform load corresponded identically with the calculations previously made.

The Boyne Viaduct was opened for railway traffic on the 5th of April, 1855. It was designed by Sir John Macneill (M. Inst. C.E.), the Engineer-in-Chief of the line, and was erected entirely under the direction of Mr. Barton (M. Inst. C.E.), the Acting Engineer, by whom the calculations for the structure were made, and the design was worked out, and from whom a full description of the mode of construction was anticipated for the next Session of the Institution.

ON PUBLIC WORKS FOR INDIA, ESPECIALLY WITH REFERENCE TO IRRIGATION AND COMMUNICATIONS.*

By Col. ARTHUR COTTON, late Chief Engineer, Madras.

THIS is a vast subject; it seems impossible to compress even the leading points of it into the compass of a short paper: you will bear with me, therefore, if I come at once to the point.

The first thing, then, seems to be the state of India in respect of public works. Besides innumerable minor works, which are required in every country fully to develop the material and even moral welfare of a people, in whatever climate, and which cannot be even touched upon here, there are, first of all, in a tropical climate, or even in an extra-tropical one which has a rainy season that is sometimes very scanty, works of irrigation.

Secondly.—In all climates, communications.

Thirdly.—Harbours.

It seems most obvious that the fundamental principle in political economy is to secure, as far as possible, an abundant supply of food, with only such an expenditure of human labour as shall leave a large surplus of the time of the community for all those things which constitute the difference between the mere animal and the intelligent being. Until a large portion of the community is set free from labouring to produce food, there can be no cultivation of the mind, even if, with the labour of all, a supply of food is secured; but if to this degree of difficulty of obtaining food there is added, from occasional failure of periodical rains, famine, the misery and evil, both physical and moral, is indescribable. Now, in a tropical climate at least, the management of the water is, according to my 30 years' experience in India, undoubtedly, and beyond all comparison, the most important thing to be attended to, in order to provide for these two things—a supply of food that shall be, first, as certain as possible, and, secondly, obtained with only a moderate degree of labour. I think this is clearly shown by this very simple fact. In India, water is raised from wells and rivers, in every district, from the Himalayas to Cape Comorin, by means of bullocks and men, for the purpose of irrigation, at an average of about 6,000 cubic yards for a pound sterling. This is an unmistakeable proof that it is worth, at least, so much, otherwise it would not continue to be raised by millions of cubic yards, year after year, at that cost; and then, further, water can be provided by means of works on a large scale, and applied to the land at the rate of 100,000 to 300,000 cubic yards for a pound. This is proved by the actual cost of large works executed by our Government.

I will only here give one instance of the provision of water on a large scale. The system of works for the irrigation of the Delta of the Godavery, 400 miles north of Madras, consisting of a weir, or anicut, as we call it, across that river, with the channels and various works of masonry required for distributing and regulating the water throughout the Delta, will cost about £300,000. The works are now approaching completion, and they are, to a great extent, in operation. The water will be distributed over 1,200,000 acres; and, allowing 4 per cent. interest on the outlay, and an equal sum for management and repairs, the actual cost of the water will be about 30,000 cubic yards for a pound. This, however, also includes the making the channels navigable, so that the whole Delta will be pervaded by a system of water communication, all the large ones being fit for steam navigation. This is certainly one of the most favourable situations for such irrigation; but if we take even 200,000 cubic yards of water for a pound, the cost is not one-thirtieth of the proved value of water for irrigation. There can be little hope that any means of cheapening food can be found to surpass this. It is just as if a man in this country found a kind of manure that would cost a pound an acre, and increase the produce by 70 bushels

---

* Paper read at the Royal Society of Arts, April 25, 1855.

of wheat, worth £30. Another proof of the effect of water is given by the Government return of all the new irrigation works in the Madras Presidency for 13 years, which showed an average result of 70 per cent. on the outlay, in Government revenue; so that, including the profit to the landowners, it could not have been less than 200 per cent. in all, or fifty times the interest of the money.

But, besides this effect of water in diminishing the labour required for raising food, there is an absolute necessity for such works, to prevent actual famine. Almost every part of India is occasionally visited by famine, from the failure of the monsoon rains; and there are few parts in which hundreds of thousands have not died of it under our rule. Only last year, in one district, the Government had to provide 100,000 people with employment for several months, while they fed them to prevent them starving.

Secondly, with respect to communications, I need not say much on the value and necessity of them, as they are equally required in all climates, though the importance of them in a vast continental country, where the distances are very great, is incomparably greater than in a small country, like England, with its natural very cheap water transit round its coast, within a comparatively few miles of every part of the country. With respect to the movement of goods, the fundamental principle seems to be *that everything is worth more in some other places than where it is*; and, consequently, that an increased value can be given to it by moving it, if it can be transferred sufficiently cheap; and things which are utterly valueless where they are found, will be of some value in other places, and hence that an increased value can be given to the product of a country, by a system of cheap transit, to an extent which cannot be calculated. But as whatever the transit costs is so much deducted from the net profit of transit, the object to be aimed at is the *annihilation of the cost of carriage*. This should never be lost sight of. The question is not, "Is such a mode of transit cheaper than such another?" but, "Is it the cheapest that can be devised for such a line of communication?" When first tram-roads were invented, they used wheels of very small dimensions, because, they said, the draught was so easy that large ones were unnecessary; but in time they have found out that there was no sense in throwing away the further advantage to be obtained by large wheels. However, that mode of reasoning is constantly applied to this day in arguing about communications; and there will be a hard battle fought before England is provided with a system of steam-boat canals, in which the goods can be conveyed at one-eighth of a penny per ton a mile; instead of the present modes of conveyance by railway at one penny, and by small canals at one-third, exclusive of tolls, and by the coast at one-third to one-seventh of a penny.

And, with respect to the conveyance of passengers, the principle seems to be, that in proportion as time and cost are diminished, is the power of communication increased in innumerable ways, many of them far beyond our perception. But time is a far more important element in the question of passenger transit than in that of goods; yet it is far less so than is generally supposed, as is proved by this, that in the summer by far the greater part of the first-class passengers travel by sea in 50 hours from London to Edinburgh, with all the risks and inconveniences of a sea-voyage, in preference to going by land in twelve, the cost of the sea transit being 14s., and that of the railway from 60s. to 80s.; from which it is evident that, even in the wealthiest country in the world, almost the whole of the travellers would prefer going at 10 miles an hour at a certain cost, than pay five times as much to go at 40 miles: and hence we conclude safely that in a poor country, like India, cheapness is the grand desideratum both for goods and passengers, and that high speed is comparatively quite insignificant.

The third essential in the way of public works seems to be harbours. No country in the world can supply itself with all that is required for a highly-civilised state of society, and, consequently, to provide for the cheap shipping and landing of goods is essential to the welfare of every country; but especially in this case, where a country like India can at once obtain all the benefits of the manufacturing skill and capital of a country far more advanced than herself by sending her own raw produce to purchase it.

The cheapness of sea transit depends in a great measure upon the safety of the shipping at the ports, and the facility of landing goods; and as the whole world is here brought into competition, upon this cost of shipment must depend whether a country's produce is saleable at all or not; and in proportion as that which a country has to sell is bulky is the importance of cheap ports to her.

It is not for the sake of her few hundred tons of indigo, but for her hundreds of thousands of tons of rice, oil, seeds, sugar, hides, &c., that it is of such consequence to India whether a ship's expenses in port are a shilling or ten per ton of goods.

We cannot proceed further with this subject without an attempt at a really fair estimate of the actual state of India at present with respect to these great essentials, public works. And it is impossible to travel a hundred miles in India without being quite satisfied on this point, that there never was a more astonishing failure in the world than ours has been in our management of India with respect to this, which lies at the very foundation of all improvement. Nay, we cannot land at many places, and, among them, at no less a place than Madras—a seat of government, and a city of 600,000 inhabitants—without unmistakeable proof of the unaccountable apathy we have shown about such improvements. This great port is not only at this moment without shelter for shipping, but without any means of avoiding the surf, so that we are still using the very native surf-boats that were found there 100 years ago; and, besides the enormous expense that is incurred in shipping goods, not a year passes without people being drowned in crossing the surf, and the most dreadful wrecks, with prodigious loss of life, take place within pistol-range of the Fort and the houses of the town, under the eyes of the governor himself, and the members of Government. Let us take, next, a district at this moment in the state in which the great mass of the country is now lying—nineteen out of twenty of the 100 and more districts into which the country is divided. Let us suppose a rich traveller: he sends on, a few days before he starts, to have fourteen men posted at every twenty-five or thirty miles to carry his palanquin, and one pair of baskets to carry seventy pounds weight of clothes. The bearers are brought from, perhaps, 50 miles, perhaps 100 miles, to their appointed stations. With these preparations he sets out, and manages, if he travels through the burning sun, to proceed at 3½ miles an hour, at a cost of from about eightpence to a shilling per mile. In each district he passes through, there is, perhaps, 50 miles of imperfectly made road, on a surface of 10,000 square miles—equal to ten English counties—perhaps not a single mile, excepting the carriage-drive at the principal European station. There are certainly some miles of made road, provided with bridges in some districts, and there is one extended line up the Valley of the Ganges; but these do not fairly represent the state of the country—they are very rare exceptions. If our traveller has goods to take up the country, and he stops at 400 miles from the port, they will reach him in six weeks, if they have not been stopped by the rivers, at a cost of £6 a ton.

Now, imagine a portion of England without a mile of made road, or canal, or railway; without a bridge, and wholly impracticable to anything but a man on foot or an animal, and even to them for several months in the year; and then suppose this tract of land to be cut off from the ocean by from 1 to 500 miles of similar country, and an idea will be formed of the state of the people in India For seven or eight months in the year, when the surface is dry, and there is no water in the rivers, goods are conveyed in bullock carts, by stages of 10 miles a day, at a cost of 4d. a ton a mile, in a country where money is about six times the value it is here, calculated from the cost of labour and food; so that this charge is equivalent to 2s. a ton a mile in England; and when we add to this, that whereas in this country the distances to be traversed to reach a port or a market, are perhaps one-fifth what they are in India, this cost of transit forms as heavy a tax as 10s. a ton a mile would be in England. If we compare simply the cost per mile, without considering the distances, it gives us a totally false notion of the state of the case.

Let us take the instance of a ton of Berar cotton, and compare its cost of transit in India and England. It costs £12, and is conveyed 400 miles for £6, to the Indian port. On its arrival in England it is conveyed from Liverpool to Manchester for, I believe, 5s.; its inland transit in England, therefore, costs one twenty-fourth of that in India: but the £6 in India represents 2 tons of human food, and the 5s. in England represents 30lbs. weight of flour, the proportion being as 1 to 150. This is the true way of comparing the state of transit in India with that in England. Now, if we consider what would be the consequence if the tax upon the transit of goods were increased in England 150-fold, we may understand what India is suffering from want of commerce, and this is the actual state of India generally. The exceptions are, that two or three main lines of road, such as the grand trunk road leading from Calcutta up the Valley of the Ganges, have been partially made; but even on these many bridges are wanting. In the Agra Presidency, in the Punjaub, and in Mysore, a good many miles of road, more or less complete, have been made. Only one district, I believe, in all India has been regularly provided with practicable roads, steadily carried on year after year for the last 30 years. So that it has now 1,000 miles on a surface of about 5,000 square miles; these are almost completely bridged, but the roads are not metalled, though they are practicable throughout the year.

There are also a few miles of railway; about 150 are now open, and they are now proceeding at the rate of perhaps 100 miles a year. They talk of carrying them on more speedily; but all that can be done in this way must be utterly insignificant towards opening India. England has already one mile of railway to 10 square miles, and even at this rate it would take 130,000 miles for India. So that if they were to proceed at ten times the present rate, it would take 130 years to open the country even to the extent England is provided with communications of this kind, and it is evident that even then several hundred thousand miles of common roads, or light railways, or canals, would be required. But further, no extent of railways would answer the purpose. As main lines of communication for goods, railways do not, and never can answer. They totally fail in the two grand essentials; they cannot convey the quantity of goods required, neither can they convey at the low price required. The Ganges is at present estimated to transport 2,000,000 tons a year, and if the whole country were provided with cheap communications, connecting it with the interior, the traffic would very soon be 5,000,000 tons; while the most crowded railway in England only conveys about 400,000 tons. And as to the cost of transit by them, it seems now clearly ascertained that the railways cannot carry at less than 1d. a ton a mile, including wear, management, and cost, exclusive of interest on capital, if the said railways were worked with fast trains; while for the long distances in India the cost ought to be reduced to one-tenth or one-twentieth of a penny a mile. In America, on the Hudson and Mississippi, it is about one-seventh of a penny. In England, a very small portion of the traffic is conveyed by rail, probably nineteen-twentieths are carried by water, either by the coast or by canal. Between Manchester and Liverpool, eleven-twelfths of the traffic in goods are by canal, according to the last parliamentary inquiry. On the east coast of England, 3,500,000 tons of coal alone are conveyed, and probably 8,000,000 or 10,000,000 tons of goods in all, while on the Great Northern Railway only 400,000 tons, as before stated, are carried. Were there a canal for 300-ton steam-boats, like the St. Lawrence Canal, between Durham and London, as it could convey goods at about half the cost of coast transit, the goods traffic would be greatly increased, and could be hardly less than 5,000,000 tons a year, the coals alone being at present 4,000,000 tons, producing a saving of more than £1,000,000 sterling a year. How much more unfit would the railways be to accommodate the goods traffic of a continent like India!

But the most remarkable exception to the state of India generally, with respect to communication, is the district of Rajahmundry, before alluded to. The new works there have already provided about 600 miles of connected water communication, and when the works are completed there will be full 1,000 miles. Thus the whole Delta will be provided with one mile of the cheapest communication to every three square miles of surface, and will be thus really and effectually opened out. Of the effect of this upon the people, an idea may be formed from this, that in the principal canal, which was opened in 1851, there passed, last year, nearly 8,000 boats, besides great numbers of rafts of timber and bamboos, in the fourth year, on a line over which there could not have been 5,000 tons moved before. But in a few years, when the whole Delta is opened, there can be no doubt that more than 100,000 tons will pass along it; and when the Upper Godavery is navigated,—and this canal forms the outlet of 130,000 square miles of country, which is throughout provided with cheap transits,—perhaps 500,000 tons will soon be conveyed by it.

Another exception is the opening of the Upper Godavery, here referred to. This case is one of the most striking proofs of the unaccountable misapprehension of the subject of communications shown in our management of India. This magnificent river and its branches, passing through the best cotton country in India—cotton purchased at about 1¼d. a lb.—a country also producing excellent wheat at from 8d. to 1s. 6d. per bushel—though proved to be navigable by the use made of it by an enterprising European house at Hyderabad, for two or three years previous to its bankruptcy, has been totally neglected by the Government, and the petty Zemindars on its banks have been allowed to stop all use of it by claiming whatever tolls they pleased, excepting that timber has been floated down the lower part. With this river passing through the middle of the cotton country, and terminating at a safe harbour, the cotton has all been hitherto carried on bullocks 400 miles, either to Bombay or to the banks of the Ganges, at an expense of £6 a ton, besides risk and damage; while it could have been carried by the river for 10s., if only the Government had attended to it, put a stop to the interference of the Zemindars, and expended a moderate sum in improving its bed. An officer has now, after several years that the matter has been pressed upon the Government, been appointed to superintend the improvement of the river. The sum of £5,000 has been placed at the disposal of the Governor of Madras, and a small steamer has been sent out. The engineer has been peremptorily ordered on no account to exceed that amount, which, as about 700 miles of river can be used, amounts to £7 a mile. Such is the view of the value of a river connecting a first-rate cotton and wheat country with the coast; a communication which, there is every reason to believe, will powerfully affect the whole empire, by supplying England with abundance of cotton.* Some further water communications are also in progress in Madras. Works similar to those in the Delta of the Godavery are under execution in the adjoining Delta of the Kistnah; and a line of canal is being executed from 60 miles north of the Godavery to Cape Comorin, 850 miles parallel with the coast, and connecting the three rivers, the Godavery, the Kistnah, and the Cauvery. A similar line is forming by connecting the backwaters for 300 or 400 miles along the west coast of the peninsula. So that within three years we may reckon upon having about 4,000 miles of connected water communication in the Madras Presidency. In Bengal, the grand canal, running along the narrow strip of country between the Ganges and Jumna for 450 miles, and with its branches measuring in all 850 miles, is also well advanced, and will form a communication of immense importance, though, strange to say, very little account of its use for navigation has been taken, and, perhaps, it will be left imperfect in that respect till the matter of communications is better understood.

There are two points particularly to be observed with respect to the communications:—

1st. That which is doing has been almost all undertaken within the last few years, and solely under external pressure; and, 2nd, that they are only isolated works; that there is not, as yet, any symptom at all of, properly speaking, a system of communication for all India being undertaken.

Nothing worth mentioning is as yet doing in by far the greater part of the districts, nor even any preparations for it.

What has been done, and is now doing, in Rajahmundry or corresponding works, according to the nature of the country should be at this moment going on in every district in India. About ten years will have sufficed to give that small tract of 3,000 square miles 1,000 miles of really cheap communication. If this were done in every district at once—and there is no imaginable reason why it should not—ten years would suffice to provide India with 100,000 miles, which would be at the rate of one mile to every thirteen square miles. The expenditure in Rajahmundry has been about £30,000 a year, and it has almost all been expended on the spot, in quarrying, building, excavating, &c. In other districts a large proportion of the outlay would be on light railways, in which case, perhaps, half the money would be spent on material; so that, with the same amount of money and local labour, a much larger amount of improvement might be accomplished.

(*To be continued.*)

* The sum not to be exceeded is just the cost of half a mile of high-speed railway; so that 700 miles of river navigation, that will carry at from one-eighth to one-fourth of a penny a ton a mile is considered exactly equal in value to half a mile of railway that will carry at one penny, so strangely perverted are the present ideas on Indian communications.

REVIEWS AND NOTICES OF BOOKS.

Italian Irrigation; being a Report of the Agricultural Canals of Piedmont and Lombardy. By Captain R. Baird Smith, H.E.I. Company's Service. 2 vols. 8vo., and 1 folio, plates. Blackwood and Sons.

Rarely have we the occasion of calling the attention of our readers to a professional work of reference as opportunely and with as much satisfaction as we do in noticing this work.

Having recently been called upon to supply a list of works best suited to the requirements and circumstances of some of our young friends and former assistants, now of the staff of civil engineers who have been appointed by the Court of Directors of the H.E.I. Company to the charge of superintending the execution of new, and the maintenance of existing public works in India, one of the works so selected by us, as especially suited to the employment upon which those gentlemen might be engaged, was the above excellent work by Captain R. Baird Smith.

The recent activity displayed by the Court of Directors in the direction of that class of improvements specially treated of by Captain Smith, and in the appointment of new men better fitted from their civil experience to carry out such improvements, as well as other descriptions of public works equally important to the progress of India and the development of its immense powers of production, warrants us, we think, in saying there is now great hope for the progress of India.

It is by arousing public attention to the neglect of public improvements, and the consequent languishing condition of agriculture, trade, or commerce, that governments are made aware of the necessity for moving in the right direction. Although this *has* been done for years past with respect to Indian matters, it is only recently that the Court of Directors appear to have awakened to the true sense of their position, as *farmers* of the vast country under their rule, and have taken means for greatly increasing the productiveness of many districts, and for establishing more rapid means of internal communication—wants so long and so much felt.

Colonel Cotton, and other great authorities upon Indian works, have done much by their zeal and constant agitation of the necessity for extensive and immediate execution of works of public want in India—works which are shown to have been highly remunerative to the Government in every case where executed; and Captain Baird Smith, in his work, clearly points out the financial advantages to be derived from the adoption in India of a thorough system of canals available for agricultural improvements.

Captain Smith entered upon the mission to the classic land of irrigation under the instruction of the Honourable Court of Directors of the East India Company, with a view to ascertain how far the system of irrigation pursued in Northern Italy, and the mode of constructing the works in connection therewith, might be beneficially employed in India.

In the introduction to his work, Captain Smith says—

"The great works for the improvement of agriculture throughout British India, which of late years have either been completed, or at this moment are in progress of execution, had naturally attracted the attention of the Government of India and its officers to that system of land irrigation which has been so powerful an agent in placing the plains of Northern Italy, even from the earliest historical period, among the richest on the face of the earth.

"To study this system in its various relations; to examine the details of its works, so famous in the history of hydraulic engineering; to investigate the principles, and note the practical application of those legislative enactments which, by universal consent, are held to be the most perfect at present in existence; to become familiar with the actual operation of that machinery for the distribution of water to the cultivators which is considered by most observers to come nearest to the type of theoretical perfection, the history of which will be found hereafter to have an almost romantic interest; and, finally, to observe carefully those sanatory arrangements which the continued experience of ages may have suggested for preserving the public health with the least possible sacrifice of individual interest—were the chief objects prescribed to me in the instructions with which I was favoured.

"I can scarcely hope that I shall succeed in completing the outline just sketched with all the detail of which the subject is capable; but I may be permitted to say, in a single sentence, that, feeling the truest interest alike in the subject and the object of the work, I have spared no personal exertions in endeavouring to give full effect to the enlightened views of the Government I serve."

And a perusal of the result of his labours will satisfy the reader how much Captain Smith has underrated his own ability to deal with the subject in a masterly and highly satisfactory manner.

The work is divided into two parts—the first, historical and descriptive; the second, practical and legislative.

The author's treatment of each of these divisions is admirable and complete; and having had access to the best published sources of information—viz., the printed books and official documents relating to these matters—as also by oral communication with the officers connected with the works, and by personal examination of the works themselves, he has evidently availed himself thereof to the fullest extent.

The personal narrative introduces the names of most of the authors consulted; acknowledges the courtesy and valuable assistance extended to him by those to whom he addressed himself for information; introduces the reader to the country through which he passed, the works he saw, and the people with whom he came in contact; and, finally, launches him into the subject of the work—*Italian Irrigation:* all this in the most agreeable style, and made highly interesting and instructive, from the circumstance that whilst he is thus agreeable, the end and aim of the author's labours are never for an instant lost sight of.

We pause before proceeding to quote some of the passages most interesting to our professional brethren, to remark that whilst we have perused the work of our author with the greatest satisfaction, we cannot but compliment the Messrs. Blackwood upon the admirable style in which they have produced it, as reflecting the highest credit upon them as publishers.

The Inventor's Guide to the Patent Office and Patent Laws of the United States. By J. G. Moore. Philadelphia: Parry and McMillan. London: Trubner and Co. 1855.

This work is the most recent upon the subjects of which it treats. Those who desire an intimate acquaintance with the practice relating to patents in the United States, would do well to consult Mr. Moore's work. In addition to the usual directions to the inventor for obtaining the protection granted by letters patent, Mr. Moore treats the laws of patents in a plain and intelligible manner, citing cases of almost every variety likely to occur in connection with that class of property. Some of the judicial decisions are very important. He has also added a feature which we do not remember to have seen in any similar work—viz., an appendix containing an account of early American inventions and discoveries in the several States of the Union; also, a general chronological account of steam discoveries, cotton data, and other miscellaneous matters of interest to the inventor.

LIST OF NEW BOOKS, OR NEW EDITIONS OF BOOKS.

* American Receipt Book. By A. S. Wright. Crown 8vo., cloth, 5s. 6d.
Encyclopædia Britannica. Vol. 8. 4to., cloth, 24s.
Engineer and Machinist's Drawing Book. 1 vol., imperial 4to., half morocco, £2.
Geological Science, including Practical Geology and the Elements of Physical Geography. By Prof. Ansted. Sewed, 2s.; cloth, 2s. 6d.
Instructions for the Analyses of Soils. By J. F. W. Johnston. 12mo., cloth, 2s.
Italian Irrigation, with an Appendix on Indian Irrigation. By Capt. R. Baird Smith, F.G.S. 2 vols., 8vo., with folio Atlas, 2nd edition, 30s.
Lessons on Art. By J. D. Harding. Pupil's edition, Part 1., 4to., 6d.
* Ornamental Penmanship. By G. J. Becker. 32 plates.
Outlines of Military Fortification. By J. S. Erlam. Sewed, 1s. 6d.
* Patent Office and Patent Laws: a Guide to Inventors. By J. G. Moore. Post 8vo., 6s.
Plane Geometry. By Prof. Young. Sewed, 1s.
Practical Geometry: a Solution of the Problems most difficult to the Practical Draughtsman. By A. Jardine. Sewed, 6d.; cloth, 1s.
Programme and Plan of the Metropolitan General Junction Railway and Roads. By G. L. Taylor, C.E. 8vo., 1s. 6d.
Statement with Reference to Capt. Carpenter's Invention of the Screw-propeller as used in H.M. Ships and Vessels of War. 2s. 6d.
The Yester Deep Land Culture. By H. Stephens. 12mo., cloth, 4s. 6d.
Theory and Practice of Great Circle Sailing. By Rev. P. Robertson. 8vo., sewed, 1s. 6d.
Trigonometry, Plane and Spherical. By Rev. J. F. Twisden. Sewed, 1s.

* All preceded by an asterisk are new American works.

CIRCULATION IN STEAM-BOILERS.

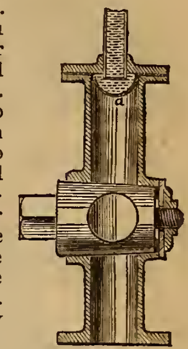
Various means have been essayed by which the deposit of scale in steam-boilers may be prevented. Muriate of ammonia and other chemical agents have been injected with the feed-water, and ingenious scale-collectors have been applied, without proving of sufficient benefit in practice to warrant their use. Surface-condensers and fresh-water apparatus have been extensively adopted, and are now entirely laid aside. The universal resort has been to blow off the water when it has attained such a degree of saturation that the scale commences to deposit, amounting, in some instances, to no less than one-half the quantity fed into the boiler by the force-pump. The transatlantic steamers carry their water at a saturation marked on the ordinary salinometer at two thirty-seconds, and on which sea water is graduated at one thirty-second. One-half the water in the boiler is converted into steam, and the other is blown overboard. And even this sacrifice is insufficient when the water is strongly impregnated with lime, which becomes fixed at a high temperature, independent of the density of its solution.

We have ever been of the opinion that some provision might be made in the boiler to meet this requirement, and are now pleased at having the opportunity of placing before our readers the result of some experiments made by Mr. Alexander Cunningham, the Chief Engineer of the United States mail-steamer *Pacific*. He was convinced there was a want of circulation through the *Pacific's* boilers, which, as our readers are aware, are of the vertical tubular variety; and conceived that it might be improved by affording a more definite channel for the currents than already existed. Short pieces were accordingly fitted into the tops of the tubes, extending them a few inches above the water-line of the boiler, for the purpose of preventing a reflux in the tubes. The water then would circulate through the tubes in an upward direction without hindrance, passing in at the lower end and out at the upper one, without tendency to return in the tubes; the downward current being supplied by the large water-spaces at the sides and between the tube-sheets. Repeated experiments, extending over several voyages between New York and Liverpool, have fully established the value of this improvement; and in every instance the tubes extended above the water-line were free from scale, while the others, in their immediate vicinity, were coated in thicknesses varying from one-sixteenth to one-tenth of an inch. The steamers of the American line are three minutes, or three seconds (we are not certain which) ahead of us in time in crossing the Atlantic: we hope they will not surpass us in efficiency. W. K. H.

CORRESPONDENCE.

IMPROVED MANOMETER.

To the Editor of The Artizan.



Sir,—I have great pleasure in laying before you a sectional sketch of an improved manometer for high-pressure steam-boilers, which it is expected will give more accurate results than any now in use.

The ordinary mercurial manometer is liable to error from the heating and consequent expansion of the air confined above the mercury; its scale also requires a correction for the weight of the mercurial column. I would therefore propose to use *oil* instead of mercury, as being an imperfect conductor of heat, and also so light that its weight need not be taken into account in graduating the scale. The oil is prevented from coming into contact with the steam by a vulcanized india-rubber diaphragm, A. The rest of the sketch will, I think, be sufficiently clear without explanation. I am, Sir, &c., &c.,

London, May 12th, 1855. W. Morshead, Jun., Engineer.

WAR VESSELS FOR SHALLOW WATERS.

To the Editor of The Artizan.

Sir,—In the year 1795 it was known to the then Lords Commissioners of the Admiralty that Brigadier-General Sir Samuel Bentham had successfully created and armed a flotilla of shallow vessels, which he afterwards commanded under the volunteer Prince Nassau Siegen, and that this flotilla had taken, sunk, or burnt no less than nine of the enemy's *ships of the line*. It was this victory which convinced Sir Samuel that, in many cases, vessels drawing but little water possessed great advantages over ships of a deep draught; that is, provided the small vessels be armed with ordnance throwing missiles of the greatest diameter in use, such as a 13-inch mortar. This view of the inefficiency of large ships in shallow waters has been confirmed by the last year's naval campaign in the Baltic, where, notwithstanding the magnificent vessels of which our fleet was composed, it effected little more than the keeping the enemy's ships in a safe harbour and the destruction of his commerce. There could be no lack of similar instances, showing the inefficiency of large vessels in shallow waters; but the lately-published Granville Papers afford a striking instance of the dangers to which ships of the line are exposed on shallow shores. Amongst those papers is a letter from Captain Freemantle, narrating particulars of Lord Nelson's attack on Copenhagen. The Captain states that, in that port, "the *Elephant* and the *Defiance* both ran on shore, and the *Nonsuch*; and at that period, when the batteries had not ceased firing, he counted no less than six ships of the line and the *Désirée* fast on shore." Captain Freemantle goes on to say that the enemy did not take advantage of our situation, "otherwise all of those ships must have been lost." It was on this occasion that vessels of a comparatively light draught of water evinced their superiority over ships of the line, for, where none of them could venture, Lord Nelson stationed the *Arrow* and the *Dart* opposite the Crown batteries, the most formidable of the enemy's works. These sloops of war were two of the six experimental vessels constructed by Sir Samuel Bentham in 1795. The *Arrow* and the *Dart* drew only about thirteen feet water, but they were armed with thirty carronades, 32-pounders; and, from the manner in which those guns were fitted, Lord Nelson considered that each of those sloops was equal in efficiency to a 90-gun ship of the line. These vessels, though stationed in shallow water, never were aground during the two or three hours that the bombardment lasted, and their casualties were but few. The same *Arrow* and *Dart* had previously gone high up the Scheldt, where not even the smallest frigate could be navigated. It is evident that the more Sir Samuel considered the subject, still more strongly he became convinced that a great proportion of our vessels of war should be shallow; and it may give confidence in his opinions, on reflecting that the innovations exemplified in his experimental vessels of 1795 have been since adopted, save only two of those improvements, namely, short metal screws in place of long bolts, and also the making the water-tanks contribute to the strength of the vessel by connecting them with the ship's side and with the decks above and below them, which two particulars still await their time. It should, however, be observed in regard to these six vessels of war, that the chief object aimed at in their construction was the application of well-known principles of mechanics to naval architecture, thitherto wholly devoid of the simplest rules of mechanism for giving strength; and the success of this innovation was fully proved in an official examination of the *Dart*, after she had been six years in active service, and had encountered and defeated many an opponent.

The efficiency of vessels of war is, at this time, of great national importance. It seems incontrovertible that whilst the enemy possesses fleets of three-deckers, we should have ships capable of coping with them; but, whether this should be by vessels of equal size, or smaller ones, is still a question that remains unsolved. Yet, however that may be determined, there cannot be a doubt but that we should possess means of annoying the foe on such shallow shores as prevail in the Baltic, not to speak of attacking him on his rivers. Sir Samuel Bentham, in his "Naval Essay," speaks of the mischief done by shot of great diameter, such as of two feet, or eighteen inches even; but, confining himself to the largest piece of ordnance then in use, a 13-inch mortar, says he could venture to name as capable of carrying such artillery—with the usual allowance of a hundred rounds of shot and ammunition, and a number of men the double of those requisite for working the guns—a vessel of the following dimensions:—

Length, 60 feet; breadth, 16 feet; draught of water, about 4 feet.

15th May, 1855. I am, Sir, &c. &c., M. S. Bentham.

FLOATING CAISSONS.

To the Editor of THE ARTIZAN.

SIR,—I am indebted to Mr. Fincham for having pointed out a typographical error in this month's number of THE ARTIZAN. The error occurs page 115, within five lines of the conclusion of my communication, where, by the substitution of *he* for *be*, Mr. Fincham's testimony is reversed—namely, he is thus made to say that he attributes the invention of *valves* in caisson gates to Mr. Scamp; whereas Mr. Fincham has uniformly stated that valves were no less the invention of Sir Samuel Bentham than the caisson gate itself.

I am, Sir, &c. &c.,

21*st May*, 1855. M. S. BENTHAM.

ROYAL CORNWALL POLYTECHNIC SOCIETY, FOR THE ENCOURAGEMENT OF SCIENCE AND THE FINE AND INDUSTRIAL ARTS.

INSTITUTED 1833.

LIST OF PREMIUMS AND PRIZES FOR 1855.

It should be understood that the premiums will not be awarded unless the judges consider the essays, models, &c. of sufficient merit to deserve this mark of approval.

1. MINE VENTILATION.—The following sums having been subscribed towards premiums for improved ventilation in the Cornish mines—

Royal Cornwall Polytechnic Society	£50
Rev. Canon Rogers..................................	10
Rev. H. Molesworth St. Aubyn......................	5
Augustus Smith, Esq..................................	5
C. F. Giesler, Esq......................................	5

the Committee have decided on dividing the amount as under:—

Two premiums, one of £40 and another of £20, to be further augmented in the same ratio as donations to the fund shall allow, to be given to the first and second best of the two mines in which, under the circumstances of the case, the ventilation shall be most complete; regard being particularly had to "close ends," and the extent to which effective ventilation is carried from the main natural draughts. The effectiveness will be tested in such manner as to the adjudicators of the premiums shall appear satisfactory.

Two premiums, one of £10 for the best model, and another of £5 for the best plan, for increasing the ventilation of mines, especially in those parts which are difficult to reach by natural ventilation.

The Polytechnic Society offers the above premiums for competition, in the hope of directing a larger portion of public attention to the importance of improving the ventilation of the Cornish mines. Tables, showing the comparative longevity of the Cornish miner, and papers connected with this subject, which have been printed in the annual reports of the Society, show the great sacrifice of health, of strength, and of life which at present occur, and indicate as one of the chief causes of these evils, working in an atmosphere which is stagnant, impregnated with deleterious gases and exhalations, and deficient in that gas which is most essential to the preservation of life.

It is conceived that new machines are not so much required as the application of principles already well known, and the introduction into common use of those mechanical aids which are allowed to be effective: the larger portion of the funds at the disposal of the Society has therefore been appropriated to encourage ventilation itself, rather than the discovery of new means for effecting this purpose. Of the three kinds of machines now employed,—the fan, the reciprocating air-pump in various forms, and what may be termed the rotatory air-pump (an application of the principle of some of the rotatory steam-engines),—it is believed that the last is not much known in Cornwall, though, from its requiring only a slow motion, it appears well adapted to the ventilation of metallic mines.

Competition not confined to members or residents in Cornwall.

2. EDUCATION OF MINERS.—A premium of Ten Guineas (two guineas by John Allen, Esq., three guineas by Sir C. Lemon, Bart., and five guineas by the Society), for the best Essay on Mining Education, as applicable to Cornwall.
3. CONSUMPTION OF COAL, &c.—A premium of Five Guineas, by John Taylor, Esq., F.R.S., for the most complete and accurate accounts of the quantity of water supplied to the boilers, the number of bushels of coals consumed, and the duty performed by an engine, for a period of not less than six months.
4. HISTORY OF IMPROVEMENTS IN MINING.—A premium of Five Pounds, by the Society, for the best Essay on or History of Cornish Mining Operations, showing the progress of improvement in any particular department during the last half-century.
5. PULVERISING ORE.—A premium of Three Pounds, by Captain T. Richards, for the best method of pulverising silver, tin, or other ores, to supersede the use of stamping; showing the position and description of pits, trunks, machine, or other frames, buddles, and everything necessary for the most economical means, in labour and time, of cleansing black tin that is mixed with pyrites, copper, &c., for the burning-house. The dip of ground 1 in 15, and scale to be 1 in 36.
6. CORROSION OF STEAM-BOILERS.—A premium of Ten Pounds, by the Society, for the best practical method of obviating the corroding effects of the *feed and injection* water on the boilers and other parts of the steam-engines used in Cornwall.
7. WATER IN MINES.—A premium of Ten Pounds, by the Society and H. English, Esq., for the most accurate account of the quantity of water found at different depths in the mines of this county, with a view to ascertain if the quantity of water increases with the depth, or otherwise.
8. IMPROVEMENT IN MINING.—A premium of Five Pounds, by Henry English, Esq., Editor of the "Mining Journal," for the best paper containing an account of any methods or plans practised in any other mining districts, advantageously applicable to the Cornish mines. To be accompanied by the necessary drawings.
9. CURING PILCHARDS.—A premium of Five Pounds, by the Society, for the successful curing of not less than 1,000 pilchards, by some method not generally adopted in this country.
   Note.—The Yarmouth method of curing herrings appears to the Committee to be worthy of attention in reference to this premium.
10. CORNISH FLAX.—A premium of Five Guineas, by the Society, for not less than 112 lbs. of flax grown and prepared in Cornwall, and sufficiently deprived of its woody fibre to render it marketable, and very greatly to reduce the cost of conveyance to any one of the principal seats of the flax manufacture.
11. LIFE-BOAT.—A premium of Ten Guineas, by Charles Fox, Esq., for a life-boat of not less than 21 feet keel, to be stationed on some part of the Cornish coast, and ready for immediate use. Such boat in its construction should possess not less than seventy-five of the one hundred points laid down by the Duke of Northumberland's Committee; a high standard as a rowing-boat and also as a sea-boat being indispensable: Capt. Washington, R.N., and Mr. Fincham, being proposed as arbitrators in case of need.
12. FISHING-BOATS.—A premium of Ten Pounds, by Major Jenkins, of Assam, in India, for the best Essay on the several descriptions of Fishing-boats used on the coast of Cornwall, and in the Scilly Islands; with particular advertence to their manageableness, capacity, and their good qualities under oar and sail; their adaptation (particularly as to safety) to their respective fisheries; containing also a comparison of our fishing-boats with those of any other coast of Great Britain or elsewhere, and suggestions for their improvement, especially with respect to the best material for their construction and the method of building, whether of iron, of double plank (similar to the launches used in Her Majesty's Navy), or of the more common method of clencher-built, or with timbers planked. To be accompanied with drawings or models.
13. PILCHARD FISHERY.—A premium of Twenty Pounds, by Major Jenkins, and Messrs. G. C. and R. W. Fox, and Co., for the best method of enclosing pilchards in deep water, and securing them in a state fit for curing—such method to be in actual operation.

MECHANICAL INVENTIONS AND IMPROVEMENTS.

Models of Machinery not displaying invention.—Naval Architecture.—Architectural Drawings.—Drawings of Machinery.

All inventions and improvements must be accompanied by accurate models or drawings, and full and explicit descriptions. The drawings, when practical, should be on a scale large enough to admit of their being seen from a distance when hung against the wall of a room; and all descriptions or communications must be written on foolscap paper, on one side only, leaving a broad margin.

The Society being desirous of encouraging excellence of workmanship in the handicraft trades, will place at the disposal of the judges a certain number of prizes to be awarded to tradesmen, apprentices, and artizans.

A few prizes will be given for useful inventions and improvements sent to the exhibition by persons residing out of the county.

LANDER PRIZES.

Charles Fox, Esq., offers to the Society, as long as he continues a member of it, the sum of Four Pounds annually; to be distributed in the respective sums of two pounds, one pound, twelve shillings, and eight shillings, in four several prizes, for the neatest and most correct maps of some one state, province, or European colony, comprising not less than 400 square miles; or a portion of not less than 100 square degrees of some uncivilised region. These prizes to be called the Lander Prizes, in commemoration of those enterprising travellers, Richard and John Lander. The principal rivers, lakes, chains of mountains, line of coast (if any), and territorial line, should be accurately delineated; and the sizes of the most important cities or towns, with their latitudes and longitudes, should be correctly marked. The maps should be accompanied by the best information (with reference to authority) respecting the great physical features of the country; as, particulars relating to the principal river flowing through it, the length of its course, its breadth at different places, its tributary streams, lakes, and canals, its periodical rise, its average fall per mile, and the rapidity of its current, the progressive increase of its alluvial deposit, and the obstructions which may be opposed to its navigation; the characteristics of the principal chains of mountains in such country, their general direction, height, geological and mineralogical features, more important passes, limits of perpetual snow, and the elevations at which various trees and plants will flourish on their sides; or information respecting the population of its principal towns and cities, with statistics of their trade and manufactures, or the natural productions of the country, its zoology, botany, &c.

It is not expected that each map will be accompanied with information on all the subjects specified; they are named as affording hints to guide the juvenile competitors, and prompt them to compilation and original research.

ANNUAL REPORT.

Communications of interest relating to the county, or papers of a scientific character, which may be forwarded to the Society, will, if approved of by the Committee, be immediately printed and circulated with the Society's Annual Report. The authors are allowed 20 copies, and any extra number at the cost of paper and printing.

Regulations for competition, &c., may be obtained on application to the Secretary, Mr. W. W. Rundell, Falmouth.

SOCIETY OF ARTS.—EXHIBITION OF INVENTIONS.

May 2, 1855.

In our last number, p. 114, we shortly noticed the Conversazione given on the occasion of the opening of this exhibition, and at pp. 117, 118, noticed a few of the mechanical inventions, models of which were exhibited.

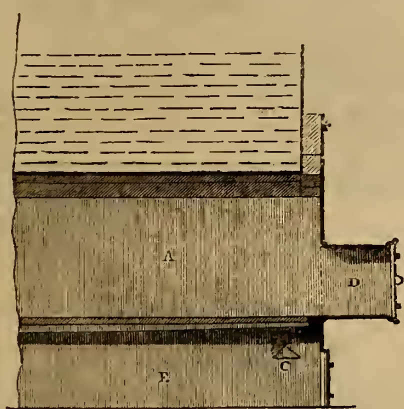
We now proceed to give, as briefly as possible, a sketch of such other inventions as our space will permit.

Of smokeless furnaces and stoves, smoke-consuming or smoke-preventing apparatus, regulators of air-draughts for furnaces, novel flues for boilers, steam-fire doors and dampers, and other varieties of contrivances having for their objects the more perfect combustion of fuel in furnaces, and the prevention of smoke, there were endless varieties and combinations.

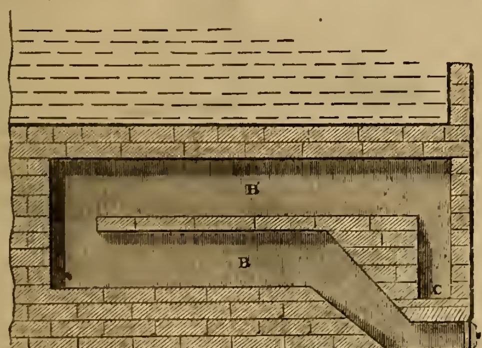
G. R. Booth's invention appears, from the drawing exhibited, to be a mode of mixing, in a second chamber, the products of combustion after they leave the furnace with atmospheric air in regulated quantities, so as to render the whole inflammable, and so available for further heat-producing.

The Rev. W. R. Bowditch exhibits plans for economising fuel and preventing smoke; he describes it thus:—

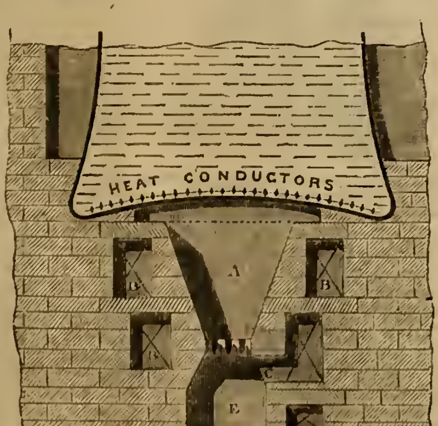
A mouth-piece, similar to that used for gas-retorts, is fixed outside the



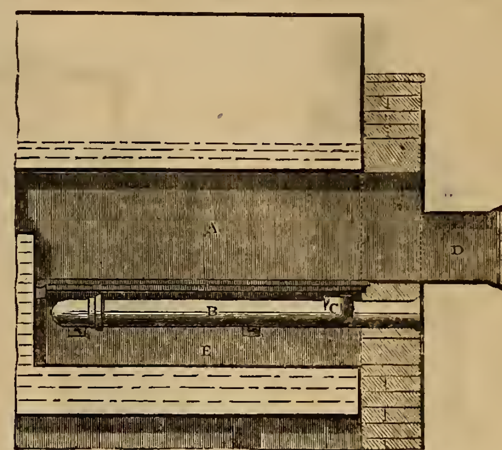
furnace, forming a continuation of it outwards. Each charge of coal is placed in this, and becomes dried and heated before it is placed upon the



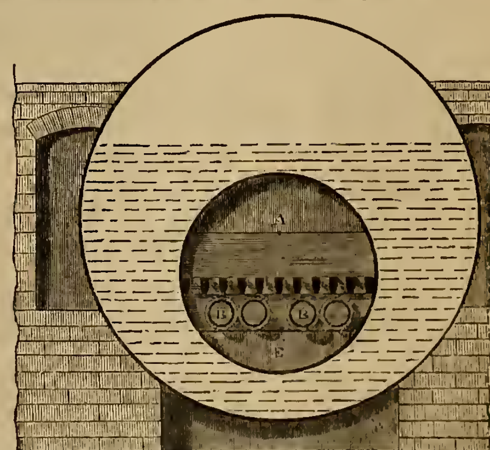
fire. Fuliginous matter given off here is consumed by passing through the burning fuel behind; steam either escaping up the chimney as such, or possibly



being in some measure decomposed and burnt. Hot coal deprived of its 10 per cent. of water will not give off smoke when placed upon a fire. Its gaseous constituents inflame almost instantly, and are given off more slowly. Side flues heat the air for combustion, and by delivering it, as shown, close to the ash-pit door (which is kept shut), a most vivid combustion is kept up at the point where the smoky matter, &c., given off by the drying fuel meets the fire. Two experiments have been tried with this apparatus, and the results obtained were as follows:—In the first instance the work done was the same—viz., the distillation of gas. The existing furnace burnt per hour—Coal, 16 lbs.; coke, 16 lbs.: the improved, only—Coal, $9\frac{1}{4}$ lbs.; coke, 8 lbs. The second experiment was in the heating of water. The fuel was the same in both cases, but whereas the old furnace only raised the temperature from 40° Fahr. to 130°



Fahr. = 90° Fahr., the improved furnace raised it from 30° Fahr. to 165° Fahr., =135° Fahr. The heat-conductors shown in the boiler are a series of connected pieces of metal, pointed at both ends, designed to save fuel by a more rapid abstraction of heat from the bottom of the boiler than can be effected by water. These are employed on the principle that heat and electricity are subjected to the same laws, and have shown a saving of from 16 to 18 per cent.



when the heated surface was perfectly clean. They will probably act even more efficiently when furring takes place, and are about to be tested in a boiler occupied in pumping 20 hours per day.

Simpson's Smoke Consumer; and Chanter and Co's. Reciprocating and Moving Fire-bars.

The features of these inventions are an inverted bridge over the bars and about half-way between the door and the back bridge; as also that the bars are made to rock by a lever under command of the stoker, who can thus keep the bars clear.

Hazeldine's Smoke-consuming Furnace has been described in The Artizan, as have been Juckes', Redpath's, and C. W. Williams' inventions.

S. J. Healey's Patent Apparatus for acting upon the Damper and Fire-door of a Boiler-furnace is a very ingenious contrivance, and deserves special notice hereafter.

Mr. Robinson's Duplex Steam-boiler, Holcroft and Hoyle's Triple Boilers of small diameter, have already been favourably noticed by us.

Of screw-propellers there were many varieties, some very novel and worthy of trial.

Mr. A. P. How contributed a series of very ingenious inventions connected with steam, the steam-engine, and steam navigation: an improvement on his Engine-room Telegraph, as described in Artizan for July, 1854; an improved Salinometer; the Patent Valve Seating; tubular packings for pistons, glands, and other purposes; and several other ingenious and practical inventions.

Dr. G. Fife's Steam and Water Gauges were also exhibited, and have been described elsewhere.

Of water-taps and self-closing cocks several varieties were exhibited.

Messrs. Gwynne and Co. exhibited models of their Double-acting Centrifugal Pumps, with some recent improvements.

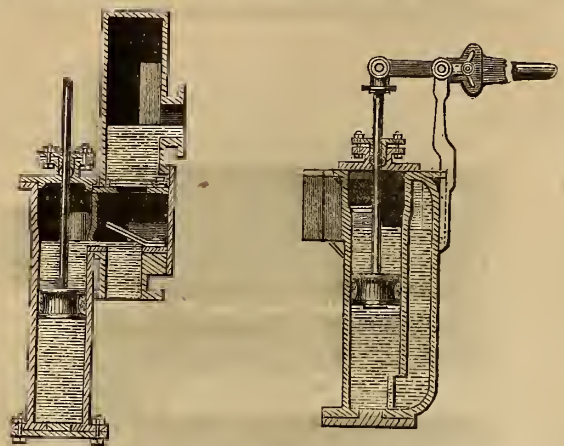
Mr. S. Holman's Patent Double-action Pumps :—

These pumps combine several important improvements, amongst which are the following, viz :—

A continuous supply is obtained from one barrel; thus doubling the quantity raised by ordinary pumps of the same dimensions in the same time.

Speedy access is permitted to all the valves simultaneously, by the removal of a single plate. This simple arrangement renders the usual mode of disconnecting pipes unnecessary.

All the valves are out of the barrel, which permits their areas to equal that of the piston, and the water passages to be proportionately large.



The hand-lever of this pump is made to vibrate on a fixed fulcrum pin and a guide pin, having slots in it equal to the versed sine of the arc, which the lever, if worked on a fixed point, would describe. This mechanical arrangement supersedes various expensive modes hitherto adopted to effect a parallel motion, and is applicable to the guiding of reciprocating rods generally.

Several railway-breaks, axle-boxes, and other apparatus connected with railways, were exhibited—as the Delostear Axle-box, Johnson's Safety Skid, Noone's Railway-break, J. Ellerthorpe's Train-retarder; W. Gosling's Safety-break for descending inclines, C. J. Brunker's apparatus for preventing collisions.

Of apparatus for communicating between the guard and engine-driver, and between the passengers and the guard, and the passengers and engine-driver of railway-trains, there were seven varieties, some simple and ingenious, and others very complicated and practically useless.

Railway station and other signal-lamps were well represented, the most important of which—Messrs. Saxby's invention—we noticed last month, and illustrated our notice with engravings. Several railway chairs and rails were exhibited, but nothing particularly calling for notice.

Amongst the Manufacturing Tools and Machines we noticed W. Ryder's Patent Forging Machine, which have been produced in excellent style, and are now extensively used, as we predicted they would be in our notice of them in 1851.

An excellent contrivance by J. Sibley and Son, for cutting circular-plates for tin-plate workers, braziers, meter-makers and others, deserves special mention, as this Circular Plate-cutting Machine will be found of very great service as a labour-saving tool in many light businesses where true circles in metals have to be cut.

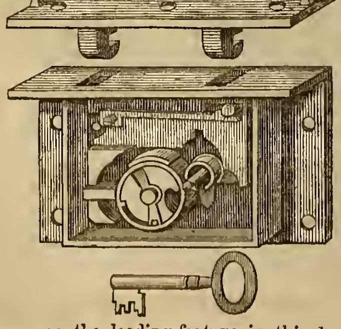
A. P. How's Patent Machine for Cutting Bolts, Rods, Wires, &c., is a simple, strong and admirable tool, possessing many advantages over other kinds of shears. (*Vide* The Artizan, February, p. 45, for description of this machine.)

J. Porter's Pillar Drilling Machine is a simple and useful tool, effecting greater steadiness while at work, and preventing the breaking of the drill.

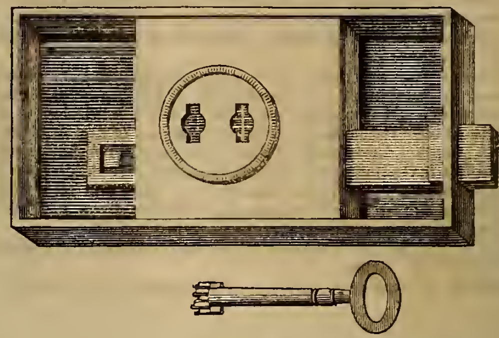
Chesterman's Rotary and Ratchet Drill, and Stansbury's Improved Drill and Bit Stock are useful. Dick's Screw Jack, and J. C. March's Improved Vice are excellent tools.

Many novelties in the way of building contrivances were exhibited, and some of them are not only novel, but ingenious and practical. Of ventilators there were several kinds, and of improved fire-places, grates, &c., a few.

Locks did not muster very strong; but Tucker and Reeves' Closed Keyhole

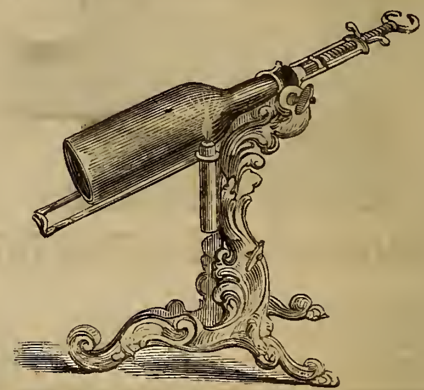


and Safeguard Locks were the leading feature in this department, and shall have special notice hereafter, as the peculiarities are that these locks cannot be unlocked while the key or any other instrument remains in the true keyhole. They are constructed so as to prevent picking by pressure or by other means, all communication with the security parts being entirely cut off by the action



of an internal revolving keyhole, which becomes absolutely closed up, so that no picking instruments whatever can remain in it before pressure can be produced. They are also so made that their security cannot be destroyed, either by tampering with the key or with the lock through the keyhole. They are cheap, durable, and not likely to get out of order, or be deranged by dirt or glutinous oil.

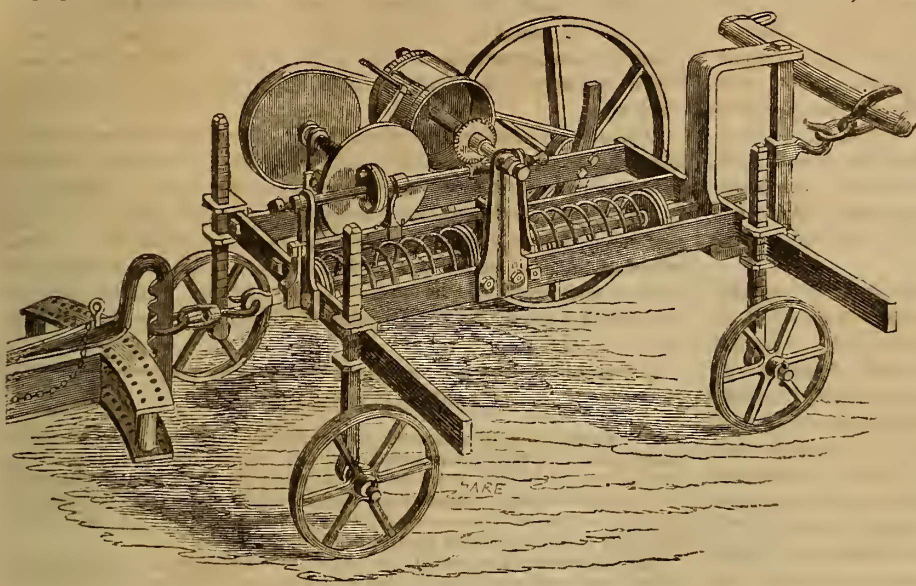
There is also a very simple, elegant, and useful contrivance by Mr. Lane—a Patent Uncorking and Decanting Machine.



By this instrument the cork may be drawn from the bottle without danger or difficulty, and the contents poured out, in whole or in part, without the slightest disturbance of the crust or sediment, and the bottle will remain at any elevation till again raised or lowered.

We have now only room for a description of Bentall's Patent Self-registering Dynamometer.

This instrument is intended to test the draught of ploughs. The force exerted by the horses being made to compress two spiral springs, the register of the draught is regulated by this compression. It is supported by an iron frame and four travelling wheels. A strap from the nave of one of these wheels drives a rigger, and with it a metal disc fixed on the same axle. The flat surface of this disc acts on an edged runner which is capable of sliding on its axle, and is, during the experiment, moved by means of a fork connected with the spiral springs to various distances from the centre of the disc proportioned to the compression of the springs; it is, therefore, driven faster or slower in direct proportion to the draught of the plough. On the same axle with the edged runner is a worm that acts on a cogged wheel, along with which revolves a drum with a speed proportioned to that of the runner; hence a line drawn by a fixed pencil on paper coiled around the drum would for equal lengths of furrow be proportioned to the draught of the plough. But motion is given to the pencil in a direction parallel to the axis of the drum, by a screw cut on the spindle carrying the disc, and the motion in this direction represents the length of furrow drawn; while the two motions combined cause the pencil to describe a diagonal, showing the variations of the draught during the experiment, the line becoming more nearly parallel with the axis of the drum as the draught is less, and *vice versâ*. A brass wheel with its edge graduated revolves also with the drum, to show the degree of draught in stones, when a determinate length of furrow is drawn. This may be used or not, as may be found most convenient.



There are several obvious advantages belonging to the peculiar construction of this instrument. In the first place, no special means are needed to obviate the vibratory motion that ordinarily interferes with other modes of construction; for the power that moves the drum acts uniformly in one direction, and the only effect produced on the drum by variation of draught is simply increase or diminution of speed.

Secondly, the draught, with all its variations, is registered by the instrument itself, without requiring the attention of the experimenter.

Thirdly, no after calculations of averages are needed.

Fourthly, while, in ordinary cases, averages are calculated from a limited number of observations, the averages registered by this instrument are the same as if calculated from an infinite series, for the additions are made at every instant, from the commencement to the termination of the experiment.

Our notices have already extended far beyond our ordinary limits, and there are many very ingenious contrivances which were exhibited, which we must defer noticing until next month.

ROYAL SCOTTISH SOCIETY OF ARTS.

April 9, 1855.

The instrument called the Gyroscope was exhibited in action and described by James Elliot, Esq.—After alluding to the general interest excited in the theory of rotatory motion within the last three or four years by the famous pendulum experiment of M. Foucault, and by the supposed connexion of the same theory with certain irregularities in the motion of rifle-balls, Mr. Elliot briefly described the various instruments employed for the illustration of the subject by Bohnenberger, Tessel, Magnus, and Foucault, and showed the greater part of the experiments performed by these parties, at the same time explaining the principle of the composition of rotatory circumstances. The very beautiful experiment of M. Foucault was described, in which a rotatory disc or syphon, nicely balanced, adjusts itself so as to place its own axis parallel to that of the earth itself, and to bring the direction of its rotation into coincidence with that of the earth; but this result was not attempted to be exhibited, in consequence of the gyroscope employed not being constructed with sufficient delicacy. A similar result, however, was shown, by giving to the disc, when in rotation, a simultaneous revolution round an external centre, when the axis and direction of rotation immediately came into parallelism and coincidence with those of revolution, the one or the other pole rising according as the direction of revolution was from east to west, or from west to east. The last-mentioned result, Mr. Elliot thought, *might possibly* be employed to throw some light on the hitherto unexplained facts of the coincidence of the direction of rotation of each planet with that of its revolution—of the coincidence in the direction of revolution of most of the satellites round their primaries, with that of the primaries themselves round the solar centre—and, finally, of the general agreement, in the direction of revolution, of all the planets round the sun, that direction probably harmonising with a revolution of the whole solar system round a remote sidereal centre. An original experiment was shown in illustration of the same theory. A sphere, made hollow from beneath to above its centre, and with a steel axis, was made to rotate with the point of the axis coinciding with the centre of gravity. A magnet was then brought near the upper external part of the axis; but, instead of drawing the axis towards it, it produced an incipient rotation *at right angles to the direction of the attracting force.* It was also stated that, in a previous experiment, a cylindrical magnet, placed vertically, was found to produce a *rotation* of the steel axis round the magnet in an opposite direction to that of the rotation of the ball, and consequently changing with it. The resemblance of the result to the effect produced by a magnet upon a wire conveying an electric current was pointed out, with a hint as to a possible similarity in their causes. The causes of the deflection of a rifle-ball to the right hand, and of the boomerang to the left, as assigned by Magnus and others, were fully explained, but not regarded as altogether satisfactory. For the illustration of the former, the gyroscope, in rotation, was suspended by a string; and when made to swing in the direction of its axis, it was found that, invariably, with a left to right rotation, the axis turned towards the right, and with a right to left rotation, the axis turned towards the left. Since rifles are all made with left to right screws, the ball requires a rotation in that direction, and consequently, as Professor Magnus considers, a deflection to the right. That, however, will depend upon the question, whether the resistance of the air has the same tendency as the suspending cord, viz., to raise the advancing extremity of the axis of rotation; and that, again, probably depends on the form of the ball.—Thanks were voted to Mr. James Bryson for contributing the gyroscope, and to Mr. Elliot for his description of it and his interesting experiments.

Monday, 23rd April, 1855.

Description and Drawing of a Reversing Turbine. By Mr. George Weir, at Messrs. Tod and Macgregor's, engineers, Glasgow.—A working model was exhibited. This invention was stated to consist of an improvement on the common turbine, which only runs the one way; consequently, when an opposite direction is required, it can only be obtained by the intervention of a clutch and reversing wheels, which method is attended with the danger of breaking down all the gearing connected therewith: whereas, the reversing turbine being supplied with two sets of arms, and a valve so adjusted that it throws the water either into the right-about or left-about arms, or stops it altogether, these evolutions can be easily performed, merely by shifting the lever connected with the valve.—Referred to a Committee.

NOTES BY A PRACTICAL CHEMIST.

Volumetric Determination of Free Sulphuric Acid.—A test acid is prepared as follows:—5 cubic centimetres of sulphuric acid (pure) at sp. gr. 1·85 are measured off and diluted with 75 cubic centimetres of water. The mixture, when cool, is of the sp. gr. 1·053, and contains 11·56 per cent. of actual acid. It is preserved in well-stoppered bottles. An acidimetric liquid is now prepared by dissolving sulphate of copper in water, and adding ammonia until the precipitate at first formed is re-dissolved. This liquid is now valued as follows, by means of the test acid:—Exactly 5 cubic centimetres of the test acid are measured off in a pipette, and poured into a test glass. The pipette is then washed with water. A burette, graduated into cubic centimetres and tenths, is filled with the cupreous solution, diluted with water if the ammonia is strong. The mouth of the burette is closed with a perforated cork, through which passes a small glass tube, connected by a caoutchouc joint with a second tube, forming a flexible mouth-piece. The burette is then held over the test glass, and a small stream of the liquid is caused to flow by blowing air into the mouth-piece. The test acid turns green, then bluish; at last a few green clouds make their appearance, but vanish again on stirring. The ammoniacal liquid is then added, drop by drop, with the greatest caution, until a slight permanent turbidity be produced. A deduction of about 0·05 of the precipitant must be made for excess. If the acidimetric liquid be of the right strength, 11·56 cubic centimetres have been employed; but if only 7 cubic centimetres have been used, 4·6 volumes of water must be added to every 7 volumes of the test fluid, to obtain a mixture of which 1 cubic centimetre indicates 1 per cent. by weight of sulphuric acid, if 5 cubic centimetres of the acid under investigation be employed in the analysis. The test fluid should be recently prepared.

Chloride of Silver as a Blow-pipe Re-agent.—In order to render the colours imparted to the flame by certain bodies, such as strontia, lime, &c., more distinct and characteristic, muriatic acid is frequently added. Gericke proposes as a substitute chloride of silver, which is kept for that purpose stirred up into a paste with water. As a support, iron wire is most suitable. The colour formed by compounds of potash is obtained in this manner with far more distinctness. Even prussiate of potash gives a distinct colouration. With salts of soda the action is less favourable, except in case of labradorite. With lithia there is little general improvement. With lime the action is favourable. No colouration, however, can be obtained with stilbite and fluor-spar. Baryta and strontia are improved; even cœlestine is made to impart a deep red colour.

In mixtures of earths and alkalies, chloride of silver is beneficial. *Petalite* yields first the colour of lithia, afterwards that of soda. *Lithion-mica* gives, first, the colour of potash, then that of lithia. Ryacolite shows, first, the colour of potash, then that of soda. Compounds of copper, even in the minutest traces, give, with the addition of chloride of silver, a fine permanent blue colour. With molybdenum, arsenic, lead, and antimony, the action is likewise improved. Antimony burns more like molybdenum. In compounds there is also an improvement. If *bouronite* be heated in the oxidising flame, a fine blue is first produced, indicating lead. On adding chloride of silver, copper is shown. The antimony in the same mineral may be shown upon charcoal, or in a tube open at both ends. Native molybdate of lead alone gives a fine blue colour; with chloride of silver this comes out more distinctly, while the tip of the flame is greenish yellow from molybdenum. Arsenic and antimony cannot thus be distinguished. Mixtures of antimony and copper, or arsenic and copper, give, first, a greenish or greyish blue colour; then, on adding the chloride, the copper appears. Copper may, in like manner, be detected, even when present as a mere trace in silver wire.

Remarks on Sulphate of Baryta.—This salt is found by Rose not to possess that perfect insolubility in dilute acids commonly ascribed to it—a consideration of great importance in analytical operations. At common temperatures it is very slightly decomposed by the alkaline carbonates and bi-carbonates, even on long standing. When boiled, it may be entirely decomposed, provided not less than fifteen atoms carbonate of potash or soda be employed along with one atom sulphate of baryta. Carbonate of ammonia does not decompose sulphate of baryta, either at ordinary or elevated temperatures.

Galvanic Extraction of Metallic Poisons.—Electric currents have been recently applied in the most brilliant and successful manner to the extraction of mercury, lead, and other metallic poisons which may have accumulated in the human system. The patient sits upon an isolated bench in a metal bath, supported also on isolating pillars. The liquid which reaches up to his neck is acidulated with nitric or sulphuric acid. He grasps the positive pole of the battery in his hand, whilst the negative pole is in connexion with the end of the bath.

Lithium and Strontium as obtained Electrolytically.—The former metal agrees with silver in colour and lustre, but is instantly oxidised by the air. It is the lightest non-gaseous body known, its sp. gr. being 0·5,936. It is very ductile, fuses at 356° F., burns with a brilliant light in oxygen, chlorine, vapours of bromine, iodine and sulphur, and decomposes water without the aid of heat. Strontium is of a light brassy yellow, very ductile, sp. gr. 2·542; decomposes water very rapidly in the cold, and burns brilliantly in oxygen, chlorine, bromine, and sulphur.

ANSWERS TO CORRESPONDENTS.

"S. P."—There is no doubt that great havoc might be occasioned by using the chloride of azote for military purposes; but so uncertain and ungovernable is its action, that friend and foe would run an equal risk. We have found that it will readily explode from an electric wave, as on passing the ball of a charged Leyden jar at some distance above it. We should feel very uneasy at the approach of a thunder-cloud, if a spoonful of this terrible liquid was anywhere in our vicinity. There is no doubt that if you could project the quantity you mention into Sebastopol, the city would vanish like chaff from a threshing-floor; but who is to prepare, convey, and fling it? The fulminate of silver, though far more powerful than gunpowder, is mild in comparison with the above-mentioned substance, and might, no doubt, be advantageously employed in warfare.

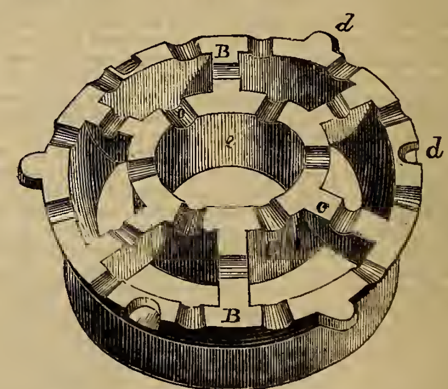
"Chemicus."—The analysis of air, so as to detect any abnormal ingredient, requires great nicety, and a most scrupulous regard to the quality of the re-agents employed. If you suspect hydrocyanic acid, you might pass by the help of an aspirator a few hundred or thousand feet through a vessel containing persulphuret of ammonium. On the application of heat, sulpho-cyanide of ammonium would be formed, were any prussic acid present, and might be detected by a persalt of iron. Ammonia may be determined by drawing the air similarly through dilute hydrochloric acid.

CAST-IRON PAVEMENT.

The subjoined cuts represent the figure and manner of laying a novel description of street pavement, lately and successfully introduced into this country. In the cities of Boston and New York I have witnessed its operations under circumstances well calculated to test its practicability to withstand the wear of travel and the frosts of winter, and in each place it has received unqualified approval.

The testimonials herewith are added in consequence of their positive merit and worth, and they are concurred in by the citizens of New York, who have had the opportunity of witnessing the success that has attended the experiment of paving a part of Nassau-street with these blocks.

The American and Foreign Iron Pavement Company, organised under the general laws of the State of New York, is the owner of Terry's patent right for improvement in cast-iron pavement for streets, embracing the United States and most of Europe; and it is now prepared to enter into contracts for the paving of streets, or for furnishing cast-iron blocks to Corporations or individuals.



The nature of the invention consists in covering the surface of a street with boxes made of iron of any convenient form or size, and divided into sections, so small as not to admit the hoof of a horse; and the compartments of iron are so arranged as to strengthen one another, and the whole pavement. The boxes are grooved, as at *c*, in such a manner as will effectually prevent the feet of horses and the wheels of carriages from slipping; they are keyed together, *d d*, and the interstices are filled with any composition made of gravel, stone, shells, &c. The ribs and rims, B *e*, extend to the bottom of each box, and the interstices also extend down. Each box has outside flanges for the purpose of keying one into another, so as to render the whole immoveable, and firmly keyed in position. Each block is about five inches deep, and one foot in diameter; but a larger size may be employed. Each block may be made with any number of compartments in it. The thickness of the rims and ribs in each block is about one inch at the top, and this thickness extends about one inch down, then tapers to a thin rim at the bottom.

The keys or flanges, and the clefts or commisures, are so arranged around the outside of each box that each key rests in a commisure of the neighbouring box, and thus each box rests upon the ground, and is also supported by three boxes, which it also aids in supporting. Thus the whole pavement is firmly linked together, and it is impossible for any one box to move or rise above or settle lower than those around it.

The grooves and interstices, radiating from the centre, prevent the possibility of slipping, and form angles over which the wheels of vehicles roll diagonally, occasioning no more jarring or noise than when going over a plain surface.

It is so constructed that the swelling or settling of the earth by the frost has a play in the cells or interstices, without displacing the iron boxes or affecting their evenness. By its slight curvature and binding together, it has a sustaining power of itself, independent of the earth beneath, and teams loaded with sand passing over it, before the cells were filled with gravel or the earth had become firm underneath, produced no perceptible impression; so that if gas or other pipes are to be laid, or repairs made, a section of it can be removed and replaced without disturbing any other portion; and should the earth settle from underneath by such repairs, it would not be injured thereby, but retain its proper position and even surface.

Two pieces of this pavement have been put down in Boston—the first being laid in the fall of 1852, in Howard-street, not one of the most travelled streets in that city; and the second piece in the fall of 1853, in Court-street, one of the most travelled streets in any city, and where it has been very thoroughly tested by a constant use of omnibuses and other heavily-loaded carriages; and, so far, not one block has been broken, nor has the pavement in either street settled, or in any manner given way; although several new locomotives, which, with the carriages on which they were transported, weighed some thirty tons, have passed over that portion in Court-street.

The test in Boston, both as to its strength and freedom from injury by frost, has been perfect; and the opinion there is unanimous that it is superior in every respect to all other pavements, particularly in its freedom from noise, dust, mud, and slipping.

Two pieces have also been put down in this city; the first in the fore part of July last, in Nassau-street, and the other a few days later, in Frankfort-street. The blocks used in this city were much smaller than those used in Boston; and from the tests thus far, no doubt exists but that they are sufficiently strong for any locality.

A superiority is claimed for this, over all other kinds of pavement, in its comparative freedom from dust, mud, noise, and slipping; and in its durability, and expense; and also in the ease with which carriages are drawn over it.

Dust.—The action of wheels on stone pavement, especially the granite and other square blocks, produces a fine dust, which is more disagreeable and injurious to goods than the ordinary dust of the street; and while the iron pavement is entirely free from this, it is comparatively free from the ordinary dust of the street, in consequence of the moisture from the earth beneath, and the compactness of the surface of the earth in the interstices.

Mud.—This pavement is also entirely free from that slimy, greasy mud formed on the square blocks, and which is so disagreeable, not to say dangerous. The surface of the earth in the interstices becomes exceedingly hard and compacted by ordinary use, and is kept about one-twentieth part of an inch below the surface points of the blocks, so that the foot resting always on these points, is kept from coming in contact with the earth.

Noise.—The noise produced by carriages passing over the iron pavement is less than on the square blocks, and much less than on the cobble pavement; and the jar experienced in the vicinity of the square blocks is not felt near this, owing to the elasticity of the iron pavement, caused by the curvature or arch formed by its peculiar construction.

Durability.—From the tests thus far made, though insufficient perhaps to enable a definite conclusion to be reached, yet it is believed, as well from these tests, as from the nature of iron, and the peculiar construction of these blocks, that the iron pavement will last from twenty-five to fifty years; and when the points shall have been worn off, and the pavement considered worn out, it will still be worth, at least, one-half of the original cost, for the purpose of being re-cast. The piece laid in Howard-street, Boston, has been in use now nearly two years, and thus far there has been no perceptible wear, the points not being worn even bright, and not one block has been broken.

Expense.—It is generally believed that the granite block pavement will prove quite as cheap in the end as the cobble, as the latter requires, at least, annual repairs. The annual cost of repairs of the cobble pavement is about 25 per cent., while the square block is less. It is believed that the repairs of the iron pavement, during the whole period of its use, would not be 5 per cent.: indeed, it is hardly possible it should reach even that small amount, if properly laid. This would be about thirty cents a square yard, for the whole period it was used.

If it be conceded that the square blocks will last ten years, and which may well be questioned, the difference in favour of the iron pavement will be very great, even if it should not last more than twenty-five or thirty years; the original cost being less than the granite blocks, even at the present unparalleled high price of iron.

Slipping.—One great objection to the granite block pavement is, that horses slip upon it; indeed, that it is really dangerous, many valuable horses being yearly killed upon it; and in this respect the iron pavement has the decided preference, as, from the nature of its construction, horses with corks to their shoes cannot slip; and in its freedom from slipping consists one of its peculiar advantages over other kinds of pavement.

Saving of Horse-flesh and Wear of Carriages.—The peculiar construction of the blocks secures a sure and substantial footing for horses; and if properly shod, they cannot slip; and they can start and draw a heavy load on it with much more ease than on any other kind of pavement; and the straining of horses caused in starting on the granite blocks, and which disables so many, is wholly avoided by the use of the iron pavement, while its smooth, even, uniform surface prevents much of the ordinary wear of carriages.

Effect on Property.—The beautiful appearance of this pavement, with its diamond form, and smooth, even surface, adds very much to the appearance of the streets; which, with its freedom from noise, dust, and mud, renders the adjoining property more desirable, and enhances its value, as will be noticed in the statements from Boston.

Removal of the Pavement for Water, Gas, and other purposes.—The blocks of the iron pavement are so constructed, that any number of them can be easily removed and replaced, and at a trifling expense, and without disturbing the adjoining blocks, or in any manner injuring the rest of the pavement; while the cost for the same with the granite block is equal to the first expense of the pavement; and as such removals for gas, water, sewers, and other purposes are frequent, this feature of the iron pavement will be found to have the decided preference over the square blocks, and prove an immense saving in the course of a series of years.

Testimonials.—The following certificate is signed by every firm doing business on both sides of Court-street, opposite the iron pavement, except one, the members of which were absent from the city at the time it was signed:—

The undersigned, citizens of Boston, doing business on Court-street, opposite the iron pavement, take pleasure in stating that the iron pavement is in our judgment superior to any other in use with which we are acquainted, particularly in its comparative freedom from noise, dust, mud, and slipping. It adds very much to the beauty of the street, and enhances the value of the property upon it; and from the test thus far made, we believe that it will last much longer than the granite block pavements.

This pavement remains as firm as it was when first put down, and still presents the same even, beautiful surface.

Boston, Sept. 7th, 1854.

Lincoln and Foss, No. 65, Washington-street; Henderson and Stanwood, 2, Court-street; A. W. Pollard, 6, Court-street; Harnden's Express, 8, Court-street; John B. Baker, 12, Court-street; C. Driscoll, 14, Court-street; Clement Drew, 18, Court-street; Samuel Rogers, 18, Court-street; Geo. K. Snow, per Bradley, 22, Court-street; Charles Allen, 22, Court-street; Tyler and Studley, 24 Court-street; S. Klous and Co., 29 and 31, Court-street; S. H. Gregory and Co., 23 and 25, Court-street; Jacobs and Dean, 21, Court-street; A. N. Cook and Co., 15 and 17, Court-street; Roberts and Whetman, 7, Court-street; Thompson and Co., 8, Court-street; Stephen Rhoades, 1, Court-street.

Boston, Sept. 8th, 1854.

I fully concur in the opinion expressed by the above persons, residing and doing business in Court-street, opposite the iron pavement.

Abbott Lawrence.

Sept. 8th, 1854.

The undersigned, street-pavers, in the city of Boston, would state that we laid the piece of iron pavement in Howard-street, in the fall of 1852, and have watched the effect of travel upon it since, and believe, from the tests thus far made, that it will last at least twenty-five years. It remains both in Court and Howard streets as firm as when laid, without having settled, or in any manner given way, and presents the same beautiful, even surface.—Gore, Rose, and Co.

New York. H.

NOTES AND NOVELTIES.

New Barrel Bolt for Doors, &c. is an Improvement on the ordinary bolt at present in use, inasmuch as the case is manufactured without a single rivet, and entirely from one piece of sheet-metal. By pressing the bolt in a suitable mould, the sheet-metal is made to surround it, accurately taking the form of the bolt and forming the case or barrel for it to slide in. By this means are secured many times the strength of the rivetted case; and it is not necessary to cut away or injure the door in fixing the bolt. The stud or knob by which the bolt is raised is not rivetted by a pin into a small hole drilled in the bolt, as is commonly done; but the upper end of the bolt is squared and taken down to a shoulder, and the knob or stud has a square eye which fits the end of the bolt, and on to which it is rivetted. It has been patented by Mr. John Phillips, Birmingham; and is made by the Patent Bolt and Latch Company, in the same town.

Holyhead New Harbour.—Some idea of the rapidly-increasing importance of this port as a harbour of refuge may be formed from the comparative numbers of vessels which have anchored there during the past and preceding year, namely:—In 1854, 1,788 vessels, with a tonnage of 137,160 tons; in 1853, 1,293 vessels, with a tonnage of 106,392 tons; showing an increase of 495 vessels during the past year, which have found a good and safe anchorage there. At one period, in the month of January, upwards of 100 vessels sought and found shelter there from the effects of a gale. The northern (or great) breakwater is at present 5,000 feet in length, and is to be extended 2,000 feet further in a north-easterly direction, by which it will give shelter to upwards of 500 additional acres of Holyhead Bay, from all points to which it is now exposed, so as to make that area a perfectly secure roadstead, and accessible to vessels in all winds. The works are carried on with great activity, there being at the present time about 1,200 men, 8 locomotives, 4 stationary engines, upwards of 60 travelling cranes (some of them with steam-power), and 40 horses employed thereon.—*From the "Liverpool Courier," May* 16, 1855.

Process for Tinning Metals. By MM. Roseleur and Boucher.—The authors tin metals by decomposing solutions of certain double salts of tin, especially the phosphate, pyrophosphate, borate and sulphite, by means of the galvanic current. A solution for this purpose is obtained by dissolving 3 kilogrms. of pyrophosphate of potash, and 508 grms. of protochloride of tin, in 200 litres of water. The temperature is raised to about 186° F.; and the bath may be kept saturated with tin by means of anodes of tin, by the action of the galvanic current. If it be observed that the bath does not deposit sufficient metal, a certain quantity of chloride of tin may be added to it; this at first forms a white precipitate, which, however, is again dissolved. A bath of this description, which had been constantly employed for a fortnight in tinning, required no addition of pyrophosphate, so that it might be expected that nothing of the kind would be necessary even for a much longer time. This process appears to be the only one proper for protecting zinc employed in roofing, in sugar moulds, and kitchen utensils, from oxidation.

Cast-iron tinned in this manner exhibits a fine silver-like appearance. The fluid for this purpose is prepared with—

Distilled water or rain-water....	500 litres.
Pyrophosphate of soda	6 kilogrms.
Commercial tin-salt....	1 ,,
Dried and fused tin-salt	$1\frac{1}{2}$,,

According to the strength of the alkaline reaction of the pyrophosphate of soda, which is not always of the same composition, the quantities of the fused and acid tin-salt must be varied. The bath must be kept at a temperature of 168°-186° F. The authors consider this composition to be the best, as its slight alkalinity precludes the disadvantage attending the use of an acid bath, which is favourable to oxidation, whilst it does not, like the strongly alkaline baths, deposit the tin of a bluish colour, nor require much washing to get rid of its taste.

At first the authors employed a separate galvanic battery, but it appears that this is only necessary in coating zinc with tin. For other metals it is sufficient to immerse these, previously well cleaned, in the bath, together with some pieces of zinc, when they will be covered with a dull coating of tin in the course of two or three hours. This may be polished with a wire-brush. If the coating of tin is required to be thick, the objects must be immersed several times. The bath may be used almost constantly; it is sufficient, before introducing new objects, to add 300 grms. of pyrophosphate of soda and the same quantity of the tin-salt. The pieces of zinc are gradually dissolved.

The bath employed in tinning zinc has the following composition:—

Distilled water or rain-water....	600 litres.
Pyrophosphate of soda	5 kilogrms.
Dried and fused tin-salt	1 ,,

Le Technologiste, 1854, p. 629.

Signalising between Guard and Driver.—Mr. R. H. Thomas, of Kidsgroove, Staffordshire, whose apparatus for blooming iron we recently described, has forwarded a short notice of an arrangement for instantaneous communication between the guard and driver of a railway train, with a powerful self-acting break. It consists of a tube in connection with a strong vessel, forming a compressed air reservoir, supplied by an eccentric on the axle of the guard's van, working a force-pump. The air-tube is connected with a safety-valve by a branch baving a stop-cock and whistle. When the receiver is full, the pump may be detached either by hand or self-acting. When the driver or stoker signals to the guard, he simply turns a cock, giving vent to the compressed air, which by a simple contrivance moves a stud between the break lever and a spiral spring on the buffer rod under the carriage body, which, by the impetus of the train, would apply the greatest force to the breaks, and stop it almost instantaneously, while a single stroke of the engine would detach every break which had been in action. Mr. Thomas proposes to employ two tubes, one on each side, with right and left hand joints for reversing the carriages, which may be connected or detached, having flexible tubes between them, while running along the platform. Mr. Thomas informs us that he makes no claim to the invention, but if any individual or company will adopt it, he freely gives it up for the public good.

Mode of producing Alcohol from Vegetable Fibre, and especially from Wood. By M. J. Ed. Arnoud.—Under present circumstances, when the manufacture of alcohol is becoming so extensive that it diverts many first materials, especially the cerealia, from their true and more useful employment, I have thought it would be of interest to present to the Academy the results of some researches on a new mode of producing alcohol, although these researches are not yet complete.

Starting from the labours of M. Braconnot, published thirty-five years ago, and upon those more recent of M. Payen, I undertook to produce a material analogous to starch, sugar, and alcohol, from vegetable fibres, and particularly from wood. My first attempts have fully answered my expectations. I have succeeded, with certain substances, in rendering soluble 97 per cent. of the substances employed, and with certain kinds of wood, in converting into sugar and then into alcohol, from 75 to 80 per cent. of the wood used.

The wood is reduced to coarse sawdust; in this state it is dried up to a temperature of 100°, (212° Fah.,) so as to drain off the water which it contains, often amounting to one-half of its weight. The wood is then suffered to cool, and concentrated sulphuric acid is poured over it with great care, and very small quantities at a time, so as to prevent the materials from heating. The acid is mixed with the wood as it is poured; then for twelve hours the mixture is let alone; after that it is rubbed up with great care, until the mass, which is at first dry, becomes sufficiently liquid to run. This liquid, diluted with water, is brought to ebullition; the acid is saturated with lime, and the liquid, after filtration, is fermented, and the alcohol distilled in the ordinary way.

In this experiment, the sulphuric acid must be at least 110 per cent. of the weight of the dry wood. Experiments now on hand lead me to hope that the quantity of acid may be considerably diminished; but even now, even with a higher proportion, the manufacture of alcohol would be economical, in consequence of the low price of the matters employed, to wit: wood, chalk, and sulphuric acid.—*Académie des Sciences, Paris, October 23rd*, 1855.

Improvements in Blowing Machines.—M. C. F. Vauthier, of Dijon, has patented a new modification of blowing apparatus, consisting of a cylinder and piston, with a solid piston-rod passing through a stuffing-box in the top of the cylinder, and a hollow one through the bottom, through which the air is ejected. Both covers have annular spaces, with valves of India rubber, or other suitable substance, opening inwards for the admission of air. At eacb stroke of the machine the air is drawn into the cylinder, and forcibly expelled through the hollow piston-rod.

Use of Lime-water in the Formation of Bread.—To neutralise the deterioration which the gluten of flour undergoes by keeping, bakers add sulphate of copper or alum with the damaged flour. Professor Liebig, however, has conceived the idea of employing lime, in the state of solution, saturated without heat. After having kneaded the flour with water and lime, he adds the yeast, and leaves the dough to itself; the fermentation commences, and is developed as usual; and if we add the remainder of the flour to the fermented dough at the proper time, we obtain, after baking, an excellent, elastic, spongy bread, free from acid, of an agreeable taste, and which is preferred to all other bread after it has been eaten for some time. The proportions of flour and lime-water to be employed are in the ratio of 19 to 5. As the quantity of liquid is not sufficient for converting the flour into dough, it is completed with ordinary water. The quantity of lime contained in the bread is small—160 ounces of lime require more than 300 quarts of water for solution; the lime contained in the bread is scarcely as much as that contained in the seeds of leguminous plants. Professor Liebig remarks that "it may be regarded as a physiological truth, established by experiment, that corn flour is not a perfectly alimentary substance; administered alone, in the state of bread, it does not suffice for sustaining life. From all that we know, this insufficiency is owing to the want of lime, so necessary for the formation of the osseous system. The phosphoric acid likewise required is sufficiently represented in the corn, but lime is less abundant in it than in leguminous plants. This circumstance gives, perhaps, the key to many of the diseases which are observed among prisoners, as well as among children whose diet consists essentially of bread. * * * The yield of bread from flour kneaded with lime-water is more considerable. In my household, 19 pounds of flour, treated without lime-water, rarely give more tban $24\frac{1}{2}$ pounds of bread; kneaded with 5 quarts of lime-water, the same quantity of flour produces from 26 pounds 6 ounces to 26 pounds 10 ounces of well-baked bread. Now as, according to Heeren, 19 pounds of flour furnish only 24 pounds $1\frac{1}{2}$ ounces of bread, it may be admitted that the lime-water bread has undergone a real augmentation."—*Annalen der Chemie und Pharmacie.*

NOTICES TO CORRESPONDENTS.

*** Our readers will observe that we have very much increased the size of the present number of The Artizan, owing to the length of several valuable articles which we preferred not to postpone until the following month's number. Among these are Lieut. Maury's very valuable paper on "Lanes for Atlantic Steamers," a subject of the highest and of immediate importance. The Chart of Fogs and Gales (Plate xliii.) illustrating this article we have been unable to get engraved in time for this number, owing to its being received late, and the necessity for perfect accuracy in its reproduction rendering the engraving a more than usually long and careful process. It will appear on July 1.

J. A.—We regret that the want of space prevents our inserting your letter respecting Muntz's metal. We find by the American journals, that that Government has ordered commissioners to investigate Muntz's metal, and such like materials employed for the sheathing of ships, bolts, and fastenings.

J. W.—We have received your note, and are obliged therefor. It often happens that mechanical contrivances of a similar character are devised for and applied to dissimilar purposes by parties unacquainted with each other's designs, each may therefore fairly claim the merit appertaining to his invention. Separated by distance, and a long period of time, together with the different circumstances under which the later invention was applied to its purpose, would not, we think, justify an exclusive claim being set up by the earlier designer who applied his invention or contrivance to the treatment of different materials.

C. E.—The remainder of your letter on the Mal-Administration of the Patent Law will appear next month.

J. T.—Your letter on Screw Steam-Colliers must also stand over.

Want of space prevents our noticing in the present number the communications by W. G., H. B. S., H. H., and others, or the works sent for review during the present month; and we must beg of our friends to forward their communications and books earlier in the month, for our convenience, as well as to ensure their being attended to.

DIMENSIONS OF NEW STEAMERS OR SAILING VESSELS.

LIVERPOOL, NEWFOUNDLAND, AND BRAZILIAN LINE OF PACKETS: "SPIRIT OF THE TIMES."

Built by Messrs. John Scott and Sons, shipbuilders, Greenock, 1853.

Dimensions—Builders' measurement.	ft.	in.
Length of keel and fore-rake ...	124	10
Breadth of beam	22	10
	Tons.	
Tonnage	$309\frac{63}{94}$	
Customs' measurement.	ft.	tenths.
Length on deck	123	4
Breadth at two-fifths of midship depth	20	7
Depth of hold amidships	13	7
	Tons.	
Register	$259\frac{79}{100}$	

Difference in tonnage, 50 tons in favour of Customs' measurement. Carries 400 tons of cargo; classed 13 years A 1 at Lloyd's. Launched at 1 P.M. on 31st December.

DESCRIPTION.

A demi-female figure-head; standing bowsprit; three masts; barque-rigged, square-sterned, and carvil-built vessel of timber; flush on deck; no galleries.

Owners, Ridley, Sons, and Co. Port of Liverpool. Commander, Mr. Mark Casson.

CREE, SKINNER, AND CO.'S CLYDE AND PERNAMBUCO LINE OF PACKETS—"CHRYSOLITE."

Built by Messrs. John Scott and Son, shipbuilders, Greenock, 1854.

Dimensions—Builders' measurement.	ft.	in.
Length of keel and fore-rake ...	120	9
Breadth of beam	24	$2\frac{1}{2}$
	Tons.	
Register	$332\frac{47}{94}$	
Customs' measurement.	ft.	tenths.
Length on deck	116	9
Breadth at two-fifths of midship depth	22	0
Depth of hold amidships	14	0
	Tons.	
Register, Sectional Act	$273\frac{25}{100}$	
Ditto, Act for Foreign Vessels ...	$276\frac{123}{130}$	

Carries 421 tons of cargo; classed 10 years A 1 at Lloyd's. Was launched at half-past 2 P.M. on 9th December.

DESCRIPTION.

A demi-woman figure-head; square-sterned and carvil-built vessel of timber; no galleries; standing bowsprit; flush on deck; three masts; barque-rigged.

Owners, Messrs. M'Arthur, Brothers, and Co. Port of Glasgow. Commander, Mr. Peter Cumming.

CLYDE AND NEWFOUNDLAND SAILING-SCHOONER "HEBE."

Built by Messrs. Robert Steele and Co., shipbuilders, Greenock, 1853.

Dimensions—Builders' measurement.	ft.	in.
Length of keel and fore-rake ...	68	2
Breadth of beam	18	6
	Tons.	
Register	$103\frac{83}{94}$	
Customs' measurement.	ft.	tenths.
Length on deck	67	5
Breadth at two-fifths of midship depth	17	0
Depth of hold amidships	9	3
Length of quarter-deck	20	1
Breadth of ditto	14	4
Depth of ditto	1	4
Tonnage.	Tons.	
Hull	$78\frac{15}{100}$	
Quarter-deck	$4\frac{38}{100}$	
Register	$82\frac{53}{100}$	

Classed 8 years A 1 at Lloyd's; carries 124 tons of cargo. Launched July 13th.

DESCRIPTION.

A woman bust figure-head; square-sterned and carvil-built vessel of timber; standing bowsprit; two masts. Port of Greenock. Owners, Messrs. Baine and Johnstone.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 15th February, 1855.

343. B. Gower, Stratford—Ordnance and projectiles.

Dated 23rd February, 1855.

400. J. Norton, Dublin—Cartridges.

Dated 1st March, 1855.

456. T. Kennedy, Kilmarnock—Wadding for fire-arms.

Dated 5th March, 1855.

401. C. L. Fowle, Massachusetts—Stitching machines. (A communication.)

Dated 6th March, 1855.

496. P. M. Parsons, Duke-street, Adelphi—Fire-arms and projectiles.

Dated 7th March, 1855.

506. J. H. Johnson, 47, Lincoln's-inn-fields—Hard india-rubber. (A communication.)

Dated 9th March, 1855.

539. W. Smith, 10, Salisbury-st., Strand—Safety harness.

Dated 14th March, 1855.

572. E. V. Gardner, 24, Norfolk-street, Middlesex Hospital—Smoke prevention and economy of fuel.

Dated 15th March, 1855.

583. N. Robinson, J. Lister, and H. Stevenson, Bradford—Looms for weaving cocoa-nut matting, &c.

Dated 26th March, 1855.

657. J. B. Dechanet and A. D. Sisco, Paris—Metallic tubes and pipes.
650. J. Gedge, 4, Wellington-street South—Gloves. (A communication.)
661. J. Britten, Birmingham—Chimney sweeping machine.
663. J. McKinnel, Glasgow—Ventilation.
665. W. Bartlett, Birmingham—Ventilators.
669. O. R. Burnham, New York—Projectiles.
671. J. Marland, Leeds—Preparing, sizing, & warping yarn.
672. C. Armbruster, Andermach, and O. Laist, Pfeddersheim—Sulphate of soda.
673. J. Shaw and J. Fielding, Lees, and L. Harrop, Oldham—Spinning machinery.

Dated 27th March, 1855.

675. J. Gedge, 4, Wellington-street South—Transferring designs to fabrics or to paper. (A communication.)
677. C. Goodyear, Paris—Moulding india-rubber and gutta-percha. (A communication.)
670. A. Turner, Leicester—Elastic fabrics.

Dated 28th March, 1855.

681. F. G. Mulholland, 44, Vincent-sq., Westminster—Fire-proof and waterproof roofing, flooring, and covering.
683. J. Higgin, Manchester—Thickener for mordaunts and colours for printing woven fabrics.
685. W. Hutchinson, Tunbridge-wells—Artificial stone.
687. J. Revell, Dukinfield—Propelling vessels.
689. G. H. Nicholl, Dundee—Laundry stoves.
691. W. H. Gauntlett, Banbury—Apparatus for cutting tools.

Dated 29th March, 1855.

693. F. W. Mowbray, Shipley, near Leeds—Axle bearings.
695. F. J. Anger, 16, Stamford-street—Preservation of vegetable substances.
697. W. Brown, 5, Catherine-street, Cornwall-road—Sheet-metal casks and kegs.
699. A. McDougall, Manchester—Consuming smoke.
701. A. Dalgety, Deptford—Steam-engines.
703. R. W. W. and R. (jun.) Johnson, 4, Waterloo-place, Limehouse—Covering for surfaces, linings, roofs, &c.

Dated 30th March, 1855.

705. A. Bère, Lille—Steam-boilers.
707. W. Crozier, Sunderland—Extinction of fire.
709. W. Tytherleigh, Birmingham—Covering iron with copper.
711. M. Prentice, Stowmarket, and T. Richardson, Newcastle-on-Tyne—Manures.
713. M. Prentice, Stowmarket, and T. Richardson, Newcastle-on-Tyne—Manures.
715. T. W. Bunning, Newcastle-on-Tyne—Steam-engines.

Dated 31st March, 1855.

717. A. Shanks, 6, Robert-street, Adelphi—Hand drilling machines.
719. J. B. Surgey, Lidlington-place, St. Pancras—Threading needles.
721. R. Hardman, Bolton-le-Moors—Looms.
725. T. R. Crampton, Adelphi—Furnaces. (A communication.)
727. T. Hedgcock, R.N., 7, Cavendish-grove, Wandsworth-road—Quadrant.

Dated 2nd April, 1855.

729. F. Phillips, Downham, near Brandon—Distributing manure, sowing seeds, &c.
731. J. Taylor, Hounslow—Covers for books.
733. R. S. Newall, Gateshead—Standing rigging of ships.
735. G. W. Friend, 52, High Holborn—Umbrellas and parasols.

Dated 3rd April, 1855.

737. F. T. Botta, Paris—Beer brewing.
739. H. Chapman, Kingsland—Supplying and adjusting electrodes used in the production of electric light.
741. P. R. Jackson, Salford—Making patterns and moulding.
743. W. H. Tooth, 2, Pilgrim-street, Kennington-lane—Floating-vessels and machinery, and steam-signals.
747. J. Cowen, Greycoat-street, and J. Sweetlong, Earl-street, Westminster—Locomotive land battery.
749. F. Joyce, Upper Thames-street—Percussion caps.
751. S. Greenwood, Sunderland—Rivets, bolts, nuts, &c.

Dated 4th April, 1855.

753. J. Crowley, Sheffield—Malleable cast-iron.
755. L. A. M. Mouchel, Paris—Joining pipes, tubes, and ducts. (A communication.)

Dated 5th April, 1855.

757. W. Goostry, G. Hulme, and C. Hough, Chedderton—Paper.
759. J. Chesterman, Sheffield—Knives.
761. C. Goodyear, Paris—Self-inflating pontoons and life preservers.
763. J. E. Frost, 135, Goswell-street—Ball-cocks.
765. H. M. Holmes, Derby—Tires for wheels.
767. A. H. A. Durant, Tong Castle, Salop—Axle & axle-box.

Dated 7th April, 1855.

769. W. B. Hays, 47, Cambridge-street, Pimlico—Breakwater.
771. H. Gerner, Moorgate-street—Polygraphic writing and drawing apparatus.
773. J. Hall, Liverpool—Grinding corn.
775. R. Husband and G. Mallinson, Manchester—Hat plush.
777. G. Walker, Belfast—Power-looms.

Dated 9th April, 1855.

779. W. Tuer, W. Hodgson, R. Hall and S. Hall, Bury—Looms.
781. D. Cope, Birmingham—Metallic spoons, forks, and ladles.
783. A. E. L. Bellford, Essex-street, Strand—Pumps. (A communication.)

Dated 10th April, 1855.

785. S. Fielding, jun., Rochdale—Lubricating pistons.
787. A. Chaplin, Glasgow—Steam-boilers and combustion of fuel.
789. J. H. Johnson, 47, Lincoln's-inn-fields—Cotton machinery. (A communication.)
791. Lord C. Beauclerk, Riding, Northumberland—Tilling and subsoil ploughs.

Dated 11th April, 1855.

792. J. Edge, Bolton-le-Moors—Steam-engines.
793. Capt. J. Addison, H.E.I.C.S., 23, Basinghall-street, and D. Sinclair, 122, Oxford-street—Scabbards and holsters.
794. C. Blunt, Wanstead, and Dr. J. J. W. Watson, Wandsworth—Artificial fuel.
795. L. and A. Oudry, Paris—Preserving wood, metal, &c.
796. J. Alderman, Denmark-street—Adjustable couches, chairs, &c.
797. J. Fletcher, Facit, Rochdale—Spinning machinery.
798. F. S. Hemming, Birkenhead—Buildings.
799. J. V. M. Dopter, Paris—Printing fabrics.
801. S. Holt, Stockport—Weaving plush.
802. F. G. Wilson, C. A. Hanson, and J. J. Wallis, Vauxhall—Camp candles and candle lamps.
803. P. A. Devy, 10, Old Jury Chambers—Coke ovens. (A communication.)
804. G. F. Wilson and G. Payne, Vauxhall—Ornamenting glass.
805. J. Norton, Holland-st., Blackfriars—Separating animal fibres from vegetable matters, and drying same.

Dated 12th April, 1855.

809. A. T. Richardson and G. Mallinson, Manchester—Piled fabrics.
810. F. Wilhelmy, Paris—Border paddles for steam-boat wheels.
811. J. Vernon, West Bromwich—Slide-valves.
812. W. Terry, Birmingham—Breech-loading fire-arms.
813. A. Cuninghame, Glasgow—Sulphuric acid and sulphates of iron and alumina.
814. J. Lalernan, Lillo—Combing flax. (A communication.)

Dated 13th April, 1855.

815. J. B. Bagary and C. Perron, Paris—Knitting machinery.
816. J. Templeton, Glasgow—Pile fabrics.
818. J. Revell, Dukinfield—Propelling vessels.
819. S. Wimpenny, Holmfirth, and J. Wimpenny, Rawtenstall—Spinning machinery.
820. J. Jarman, Masborough—Horse-shoes.
821. R. A. Brooman, 166, Fleet-street—Treatment of fatty and resinous matters. (A communication.)
822. T. Hill, Walsall—Nails. (A communication.)
823. G. Turner, Northfleet—Tents and marquees.

Dated 14th April, 1855.

824. J. Denoual, Jersey—Enveloping medicinal preparations with soluble substances.
825. J. Armstrong, Normanton Station, and J. Livingston, Leeds—Permanent way.
826. W. Gossage, Widnes—Soap.
827. J. A. Herbert, Guildford—Conical propellers.
828. W. Reid, Holehouse Neilston, Renfrew—Finishing textile fabrics.
829. T. Kennedy, Kilmarnock—Propellers.
830. G. J. Seulfort, Maubeuge—Screw-wrenches.

Dated 16th April, 1855.

831. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Felted tissue. (A communication.)
832. R. M. Ordish, Copenhagen—Permanent way.
833. R. Husband, Manchester—Hat plushes.
834. H. Holmes, M.D., Clifton-road, Maida-vale—Treating the human body by gases, vapours, and electricity.
835. E. H. Bentall, Heybridge—Harrows.
836. J. Cowley, Quenington Mills, Gloucestershire, and D. P. Sullivan, Stockwell—Paper.
837. G. Beard, Birmingham—Label and stamp setter.
838. W. Bull, Lupus-street, Pimlico—Axle bearings & axles.

Dated 17th April, 1855.

839. A. W. Callen, Camberwell; J. West, Guernsey; and G. W. Lewis, Bristol, U.S.—Tents.
840. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Nails, bolts, rivets, &c. (A communication.)
841. P. A. Devy, 10, Old Jewry-chambers—Swing looking-glasses. (A communication.)
842. R. Milligan, Harden, Bingley—Wool, mohair, or alpaca fabrics.
843. G. F. Wilson, Vauxhall, and W. De la Rue, Bunhill-row—Fluids for lamps.
844. C. Crapelet, Montmartre—Tompion for cannon and other fire-arms.
845. E. E. Allen, 376, Strand—Steam-engines.
846. P. Levy, Edinburgh—Wrapper.
847. R. C. Clapham, Ardrossan—Salts of baryta and artificial iron pyrites, &c.
848. C. Foster, Warrington—Railway signals.

Dated 18th April, 1855.

849. H. Woodhouse, Stafford—Railway crossings.
850. F. L. Han Dauchell, 4, Arthur-terrace, Caledonian-road—Regulating fluids and indicating pressure.
851. L. Dameron, Paris—Carriages.
852. J. Fordred, Hampstead—Reflecting surfaces.
853. J. Kay, Bonhill, N.B.—Printing textile fabrics.
854. R. Bridge, Chadderton—Power-looms.
855. J. H. Johnson, 47, Lincoln's-inn-fields—Moulding and casting fusible or plastic materials, and covering articles with same. (A communication.)
856. B. Cook, Birmingham—Horse-shoes.
857. W. Madeley and T. Hanlon, Manchester—Looms.
858. J. Lawson and S. Dear, Leeds—Combing machinery.
859. F. Russell, 13, Cumberland-market, Regent's-park—Hanging window-sashes.
861. W. V. Edwards, Swindon—Portable boiler and cooking apparatus.

Dated 19th April, 1855.

862. D. Pallier and E. Taylor, Broad-st., Lambeth—Soap.
863. T. Lees, Birmingham—Metallic pens.
864. E. and W. Howes, Birmingham—Carriage lamps.
866. J. Hindle, Accrington—Printing woven fabrics.
867. W. Bishop, Old Fish-street-hill—Ornamenting writing papers.
868. A. V. Newton, 66, Chancery-lane—Machinery for crushing and grinding mineral substances. (A communication.)
870. W. Jones, Rhodes, near Middleton—Printing fabrics.
871. P. Lear, Boston, U.S.—Horizontal submerged propellers.
872. F. Jacot, Paris—Starch.
873. W. Savory, Gloucester—Crushing grain and cutting chaff.
874. J. Atherton, W. Boyes, and W. Lancaster, Preston—Temples for textile fabrics.
875. J. H. Johnson, 47, Lincoln's-inn-fields—Articles of hard india-rubber or gutta-percha, or compounds, &c. (A communication.)
876. J. H. Johnson, 47, Lincoln's-inn-fields—Railway-breaks. (A communication.)

Dated 20th April, 1855.

877. J. C. Pearce, Bowling Iron Works, Bradford—Pipe joints.
878. L. Sardieu, Paris—Letters and figures for signs, &c.
879. W. Ryder, Bolton-le-Moors—Slubbing and roving machinery.
880. H. Macé, Paris—Transferring colours or metals in design on and from paper and stone on to surfaces. (A communication.)
881. C. L. V. Maurice. St. Etienne—Carbonizing steel.
882. J. A. Manning, Inner Temple—Agitation of fluids and solid matters contained therein.
883. J. Lord, Rochdale—Temples for power-looms.
884. S. C. Lister, Bradford—Treating rheea plant.
885. H. Allen, New York—Valves.
886. R. Bright, Broad-street—Lamps and lamp-wicks.
887. W. L. Bennett, Wolston—Seed-drills.
888. A. V. Newton, 66, Chancery-lane—Bolt machinery. (A communication.)
889. J. Drury, Paddock, near Huddersfield—Preventing explosion of steam-boilers.

Dated 21st April, 1855.

890. E. Pettitt, Manchester—Spinning machinery.
891. W. Gerhardi, Manchester—Preventing straps lapping round shafts.
892. W. Hadfield, Manchester—Looms.
894. J. Barnett, 134, Minories—Smiths' hearths. (A communication.)
895. W. P. Sharp and W. Weild, Manchester—Spun or thrown silk thread.
896. J. H. Johnson, 47, Lincoln's inn-fields—Prevention of smoke. (A communication.)
897. J. H. Johnson, 47, Lincoln's-inn-fields—Spinning machinery. (A communication.)
898. W. Winter, Nottingham—Warp-looped fabrics.
899. W. A. Edwards, 87, Brook-street, Lambeth—Separating metals from metallic substances.
900. W. C. T. Schæffer, Bradford—Treatment of waste washwaters of mills.
901. S. Walsh and J. Brierley, Halifax—Belt, band, or strap fastener.

Dated 23rd April, 1855.

902. H. Balan, Paris—Transporting passengers and goods
903. J. Whitworth, Manchester—Ordnance fire-arms and projectiles.
904. J. Wright, 12, Sussex-terrace, Islington, and E. Brimble, 32, Cheapside—Stays or corsets.
905. J. Orr and J. Templeton, Glasgow—Figured fabrics.
906. A. Jenkin, Zell-on-the-Moselle—Furnaces for the reduction and calcination of lead and copper ores.
907. A. V. Newton, 66, Chancery-lane—Separating substances of different specific gravity. (A communication.)
908. W. Gossage, Widnes—Soap.

Dated 24th April, 1855.

910. J. Taylor, King-st. Westminster—Propelling vessels.
911. W. W. Richards, Birmingham—Revolving fire-arms.
912. J. Horsfall, Manchester—Mitreing sashes.
913. J. and G. Hunter, Leysmill, Forfar—Stone-cutting machinery.
914. F. McKenna, Salford—Power-looms.
915. F. J. Utting, Wisbeach—Land-rollers and clod-crushers.
916. M. A. Muir, Glasgow—Railway chairs.
917. C. P. Smyth, Edinburgh—Astronomical and geodetical instruments.
918. C. Jordan, Newport—Discharging cannon.

Dated 25th April, 1855.

921. L. A. Avisse, Paris—Lubricating revolving shafts.
923. J. Wallace, jun., Glasgow—Cleansing textile fabrics.
924. M. Mason, Dukinfield—Metallic sole-tips and heels.
925. J. J. Victory, Henrietta-st.—Marking out curved lines upon wood and stone, and boring and sawing wood.
926. J. Black, Hampstead-road—Axles, shafts, and bearings.
927. J. Hunter, Liverpool—Distillation of turpentine, &c. (A communication.)
928. A. E. L. Bellford, 32, Essex-street—Planing screw nuts and bars. (A communication.)
929. A. E. L. Bellford, 32, Essex-street—Gas regulator. (A communication.)
930. A. E. L. Bellford, 32, Essex-street—Seamless garments, &c., of felt. (A communication.)
931. A. E. L. Bellford, 32, Essex-street—Weighing machine. (A communication.)
932. J. B. Wilkin, Helston—Stamping and dressing ores.
933. A. E. L. Bellford, 32, Essex-street—Chaff-cutting machine. (A communication.)
934. A. E. L. Bellford, 32, Essex-street—Lock for sliding doors. (A communication.)
936. S. Draper, Lenton, Nottingham—Stopping railway trains.
937. J. Jeffreys, Kingston-hill—Raising, diffusing, or injecting fluids.
938. E. Frankland, Manchester—Treatment of alums and products therefrom.
939. G. A. Huddart, Brynkir, Carnarvon—Motive power.
940. J. Peabody, Old Broad-street—Haymaking machine. (A communication.)
941. J. Silvester, Smethwick—Spring balances to steam-valves.
942. G. A. Huddart, Brynkin, Carnarvon—Motive power.

Dated 26th April, 1855.

943. J. Elce and J. Bond, Manchester—Protecting revolving shafts and mill-work.
944. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Preventing escape of fluids. (A communication.)
945. A. E. L. Bellford, 32, Essex-street—Slide-valves. (A communication.)
946. W. Shears, Bankside, Southwark—Gunpowder magazines.
947. T. H. Burley, Ohio—Making dovetails.

Dated 27th April, 1855.

948. Capt. R. P. Coignet, Paris—Rendering tissues waterproof.
949. P. A. le Comte de Fontaine Moreau, Paris—New material for bearings. (A communication.)
950. A. Crosskill, Beverley—Turning cut grasses or hay.
951. T. Page, Middle Scotland-yard—Ordnance.
953. J. C. G. Massiquot, Paris—Lithographic presses and inking apparatus.
955. H. Collett, 12, Grosvenor-street, Islington—Pumps.
956. E. Myers and J. W. Potter, Rotherham—Stoves.
957. R. Clark, Strand, and J. T. Stroud, Birmingham—Lighting.

Dated 28th April, 1855.

958. T. and J. Knowles, Manchester—Steps and bolsters for spinning machinery.
959. D. Warren, Exmouth—Motive power.
960. F. J. W. Packman, M.D., Puckeridge, Herts—Projectiles.
961. A. V. Newton, 66, Chancery-lane—File-cutting machinery. (A communication.)
962. W. E. Carrett, Leeds—Motive-power engines.
963. J. Marsh, 13, Store-street—Pianofortes.

Dated 30th April, 1855.

964. R. Burns, Liverpool—Propelling vessels.
965. E. Acres, Waterford—Desiccating and cooling air.
966. J. Walworth and D. Taylor, Manchester—Stand pipe for hydrants.
967. W. Johnson, 47, Lincoln's-inn-fields—Gas regulator. (A communication.)
968. A. Buchanan and J. Barclay, Catrine, N. B.—Finishing textile fabrics.
969. H. Francis, 456, West Strand—Boots and shoes.
970. P. Dépierre, Paris—Dyeing. (A communication.)

Dated 1st May, 1855.

971. T. Torbitt, Belfast—Treatment and preparation of potato.
972. T. Hunt, Crewe—Permanent way.
973. W. Essie, Gloucester—Stopping railway trains.
975. W. Hartley, Bury—Safety-valves.
976. J. E. Boyd, Lewisham—Ship's course indicator.
977. G. Fisher, Cardiff—Railway buffer.
978. L. W. Wright, Birmingham—Locks.
979. W. and J. Banks and H. Hampson, Bolton-le-Moors—Bleaching yarns.
980. R. Adcock, Wolverhampton—Purifying alcoholic liquids. (A communication.)
981. W. Hemsley, Melbourne, near Derby—Cutting warp fabrics.

Dated 2nd May, 1855.

983. T. Lambert, Harrington-square—Pianofortes.
984. F. W. Harrold, Birmingham—Frames of slates. (A communication.)
985. S. W. Campain, Deeping Fens—Filling sacks.
986. H. Lee, jun., Lambeth, and J. Gilbert, Hackney-road—Mixing concrete.
987. T. R. Bridson, Bolton-le-Moors—Finishing textile fabrics.
988. M. A. C. Mellier, Paris—Paper.

Dated 3rd May, 1855.

989. W. Basford, Penclawdd, Glamorganshire—Purifying coal gas, and obtaining useful residuum.
990. J. Burgess, jun., Birmingham—Comb.
991. W. Rowett, Liverpool—Fitting, handing, and reefing vessels' sails.
992. J. Platt, Oldham, and J. Taylor, Hollingwood, near Oldham—Looms.

Dated 4th May, 1855.

993. T. Horton, Birmingham—Charcoal and pyroligneous acid.
994. F. Fletcher, Birmingham—Water-closets.
995. W. H. Marks, London—Signalling approach of vessels at sea.
996. R. Thiers, Lyons—Stretchers of umbrellas and parasols.
998. J. Lecassagne and R. Thiers, Lyons—Electrometric regulator.
999. J. Hamilton, jun., Liverpool—Iron girders.
1000. D. Dalton, Chester—Smelting furnaces.
1001. J. Trotman, 42, Cornhill—Screw-propellers.

Dated 5th May, 1855.

1002. R. Midgley and G. Collier, Halifax—Preparing yarn.
1004. A Brandon, Paris—Heating and warming apparatus.
1006. M. Butcher and T. H. Newey, Birmingham—Forge hammers.
1008. H. G. A. Pecoul, Paris—Generating power in steam-engines.

Dated 7th May, 1855.

1010. J. Pearson, Totterdown, near Bristol—Fastening tires on wheels.
1012. D. Foxwell, Manchester—Wire cards.
1014. E. Tyzack, Sheffield—Scythes.
1016. J. Hands, Epsom—Furnaces.
1018. J. H. Johnson, 47, Lincoln's-inn-fields—Paper and cardboard. (A communication.)
1020. J. H. Johnson, 47, Lincoln's-inn-fields—Prevention of smoke. (A communication.)
1022. J. Lewis, Holborn—Soap.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

893. H. Schoofs, St. Gilles, near Brussels—Making, fixing, or attaching artificial teeth, gums, and palates.—21st April, 1855.
909. H. J. Iliffe and J. Newman, Birmingham—Manufacture of covered buttons.—23rd April, 1855.
920. W. Symington, Little Bowden, Northampton—Preparing peas and pearl and Scotch barley for culinary purposes.—25th April, 1855.
954. M. Lyons, Suffolk-street, Birmingham—Enamel for coating metals and bricks.—27th April, 1855.
1061. N. Brough, Birmingham, Slide buckles.—11th May, 1855.
1066. D. Caddick, Ebbw-Vale Iron Works, Monmouth—Puddling furnaces—11th May, 1855.
1067. A. Warner, 11, New Broad-street—Combining sheets of copper or its alloys with lead, tin, zinc, nickel, gold, silver, platinum, or alloys containing these metals, or some of them, with or without the addition of copper, antimony, bismuth, arsenic, manganese, or mercury.—12th May, 1855.
1068. A. Guild, Manchester—Process of bowking—12th May, 1855.

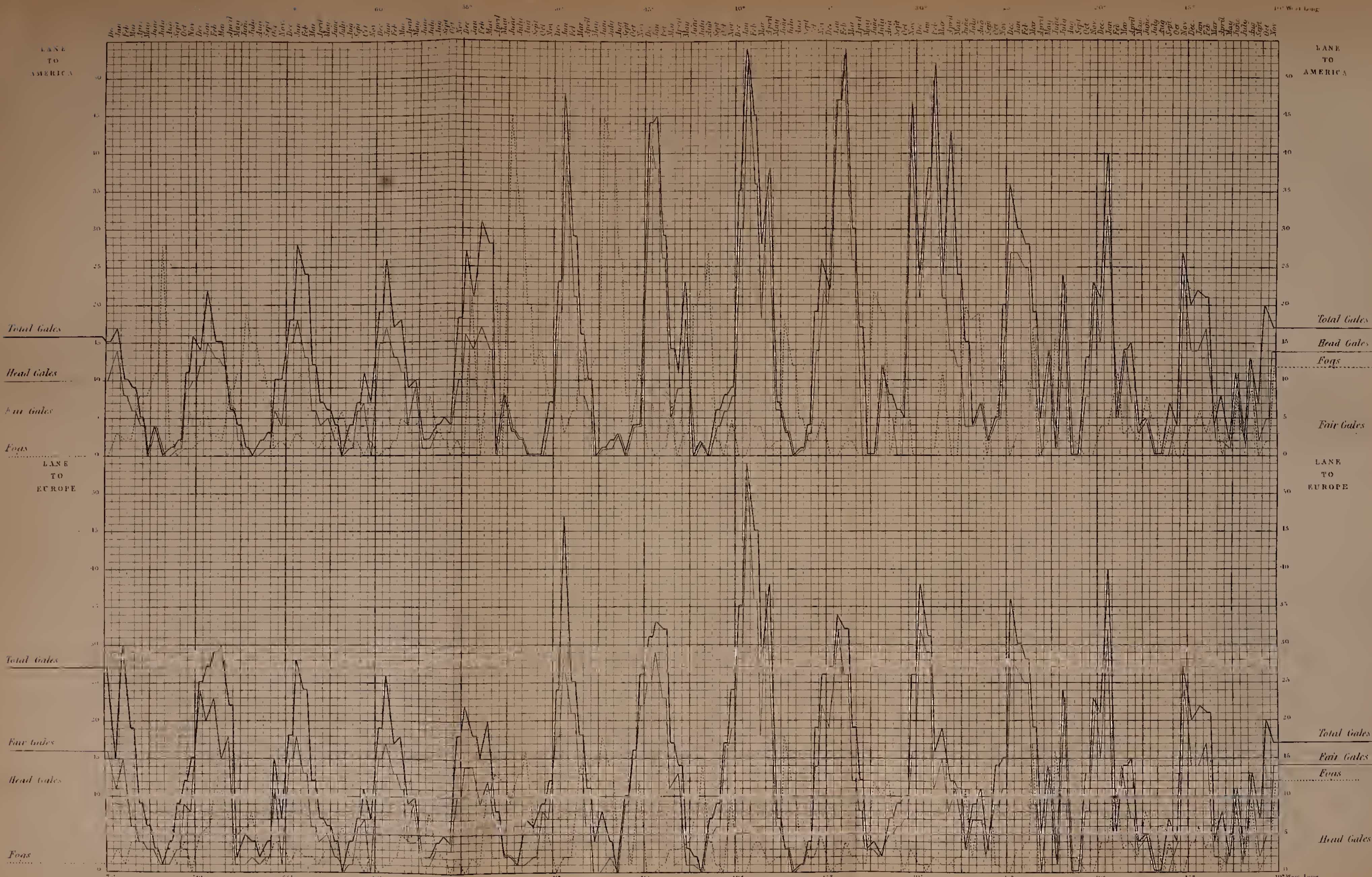
DESIGNS FOR ARTICLES OF UTILITY.

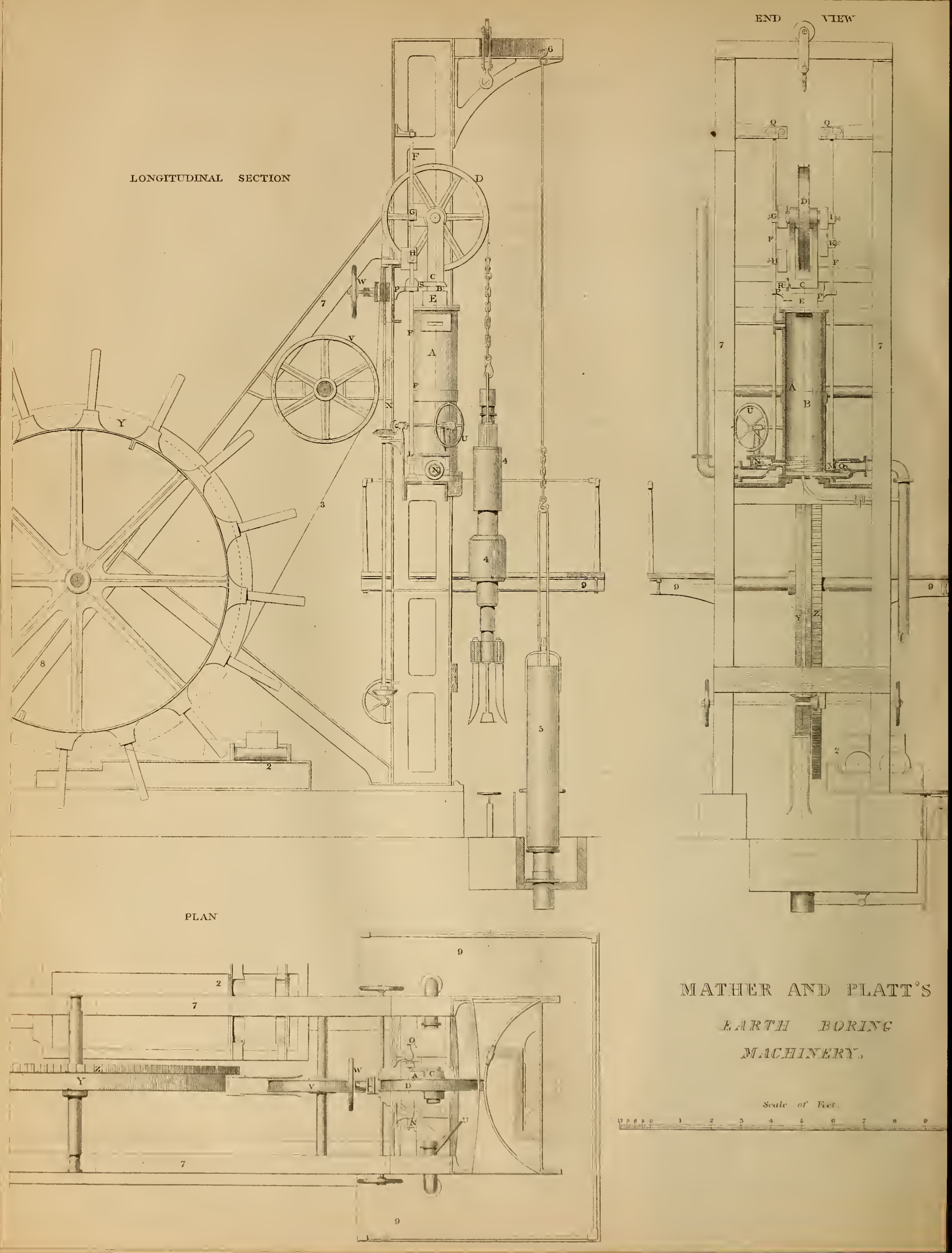
1855.

April 26. 3710. John Southgate, 76, Watling-street, "Portable camp bedstead."
„ 26. 3711. George Epitaux, 3, Pall-mall, and Levi Stead, 97, Norton-street, "Improved apparatus for freezing or icing creams, &c."
May 4. 3712. Alexis Soyer, Scutari, "Scutari tea-pot."
„ 7. 3713. Wm. S. Adams and Son, 57, Haymarket, "Improved portable coffee-mill."
„ 9. 3714. Charles Rowland, Higher Tranmere, Chester, "Improved shirt-collar with elastic button-holes."
„ 9. 3715. Wm. Langdon 9, Duke-st., Manchester-sq., London, "William Langdon's saddle."
„ 12. 3716. George Waide Reynolds, Birmingham, "Fastenings for stays, & other articles of dress."
„ 15. 3717. Colin Pullinger, Selsey, near Chichester, "Self-acting trap for catching rats & mice."
„ 21. 3718. Rev. James Burrow, Ashford Parsonage, near Bakewell, "Smoke-preventer."
„ 21. 3719. George Wilkins, Guildford, Surrey, "Improved semicircular-end black or sharp key for pianofortes."
„ 21. 3720. Henry Doulton and Co., Lambeth, "Water-closet basin and trap."
„ 21. 3721. William Graham, 8, Noble-street, Cheapside, "Brace ends."

PLATE 43

GALES AND FOGS ALONG THE STEAM LANES ACROSS THE ATLANTIC.



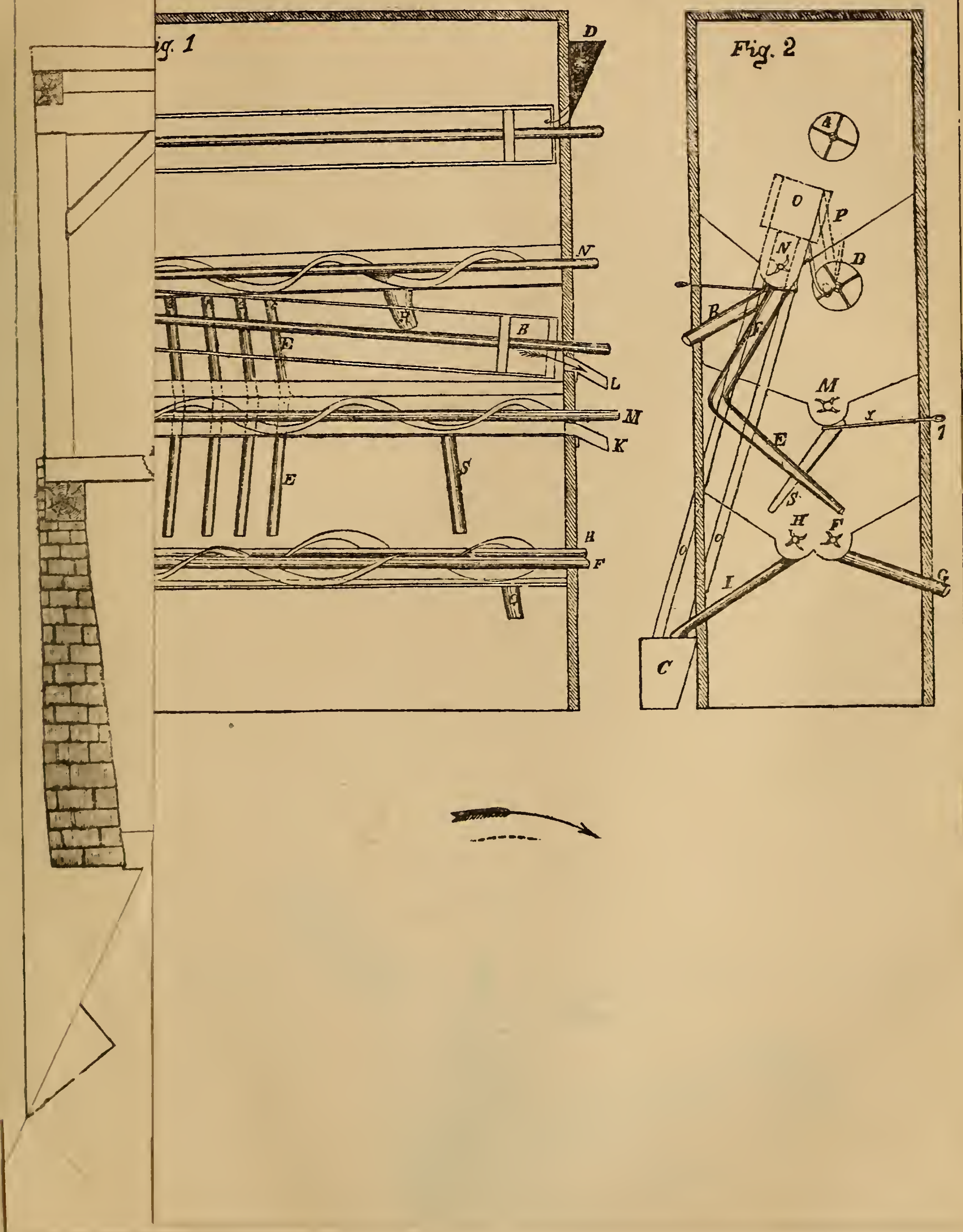


MATHER AND PLATT'S

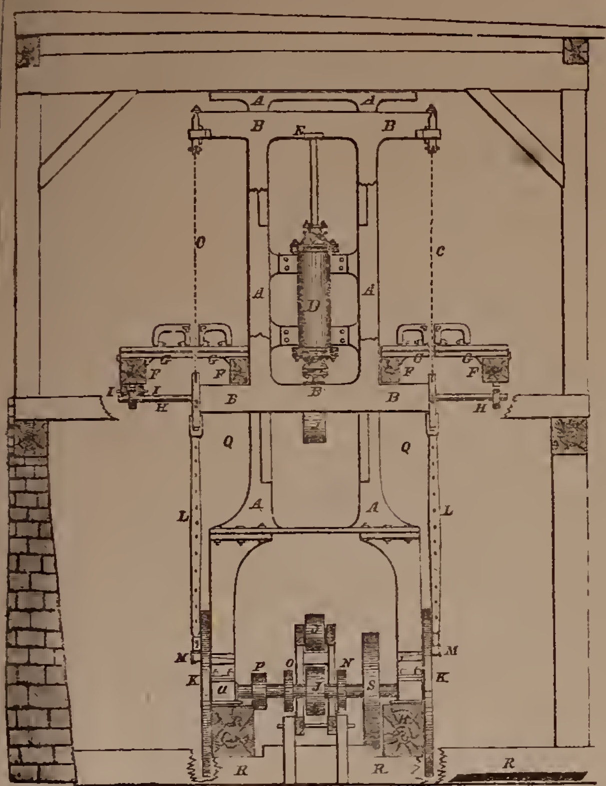
EARTH BORING

MACHINERY.

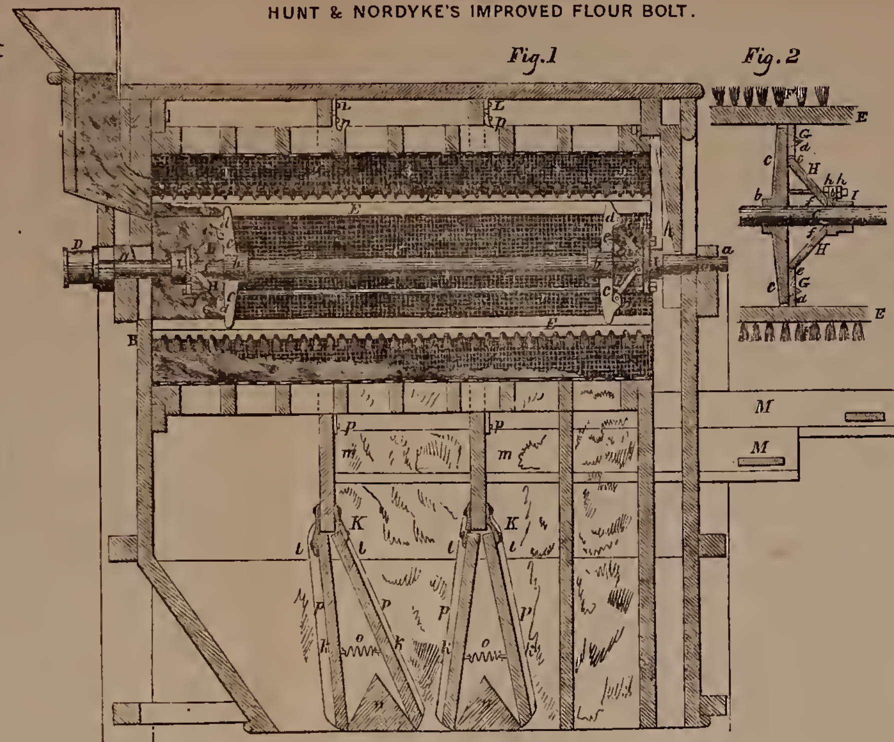
STOUFFER'S IMPROVEMENTS IN FLOURING & BOLTING.



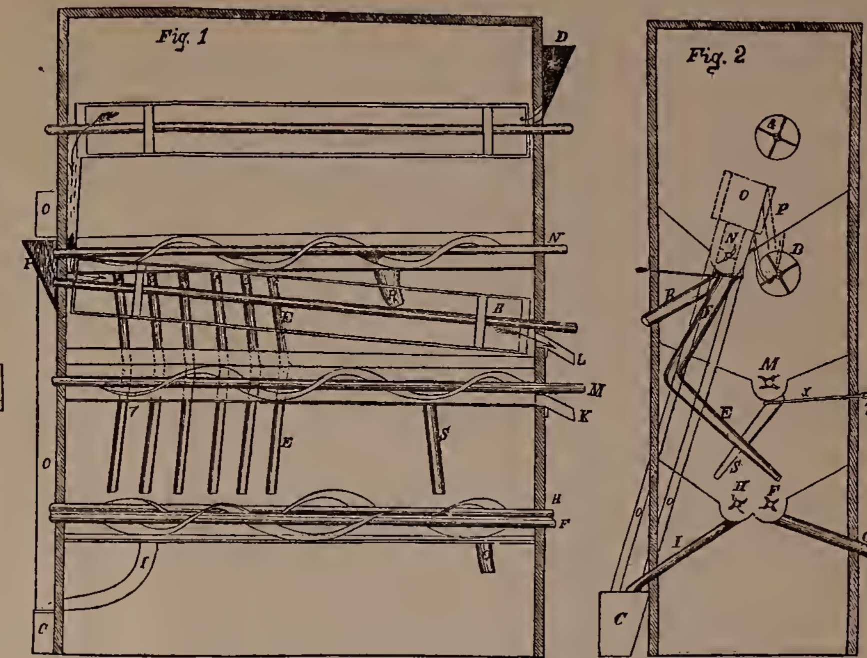
BROWN'S IMPROVED SAW MILL.

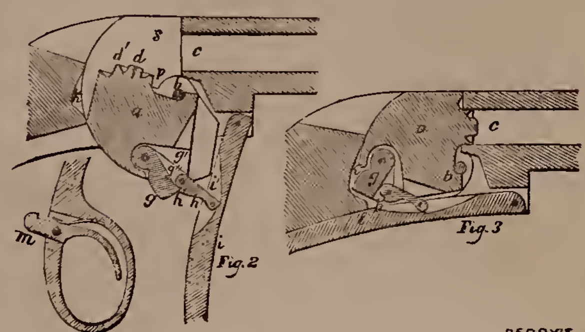


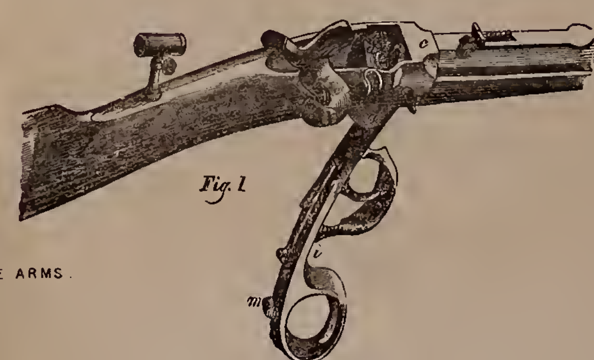
HUNT & NORDYKE'S IMPROVED FLOUR BOLT.



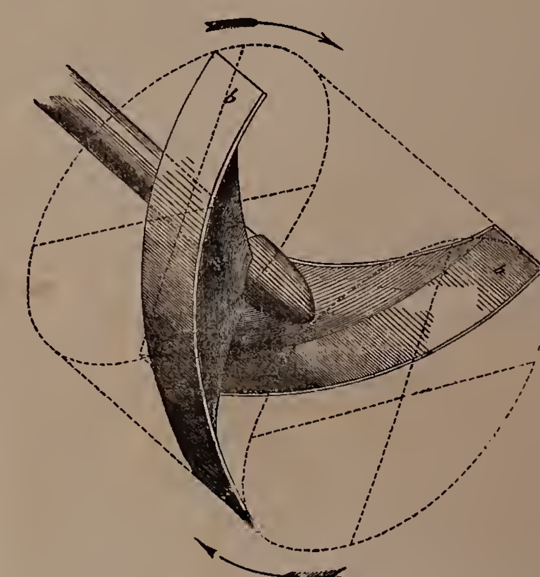
STOUFFER'S IMPROVEMENTS IN FLOURING & BOLTING.







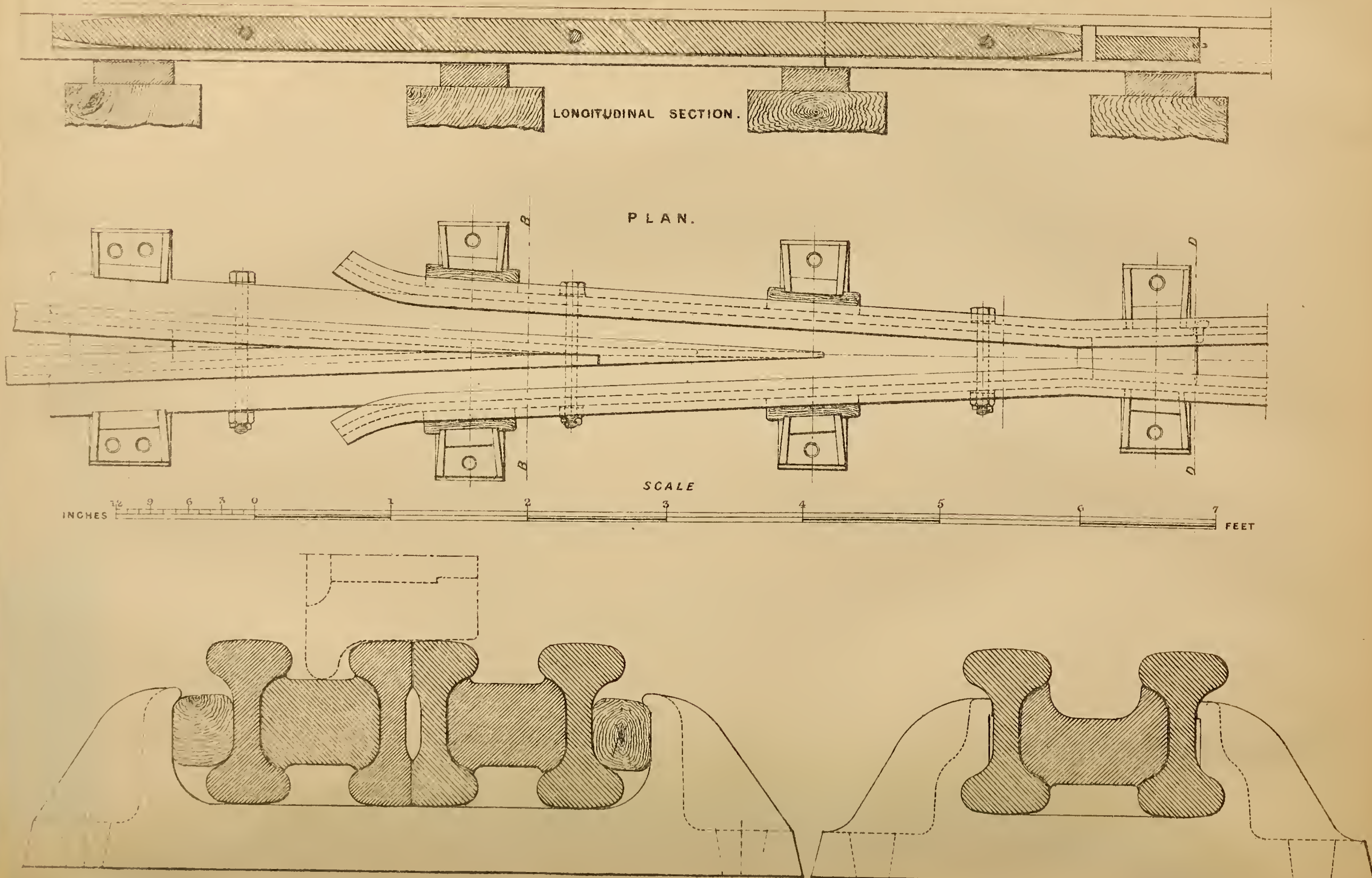
PERRY'S BREECH LOADING FIRE ARMS.



TYSON'S PROPELLER.

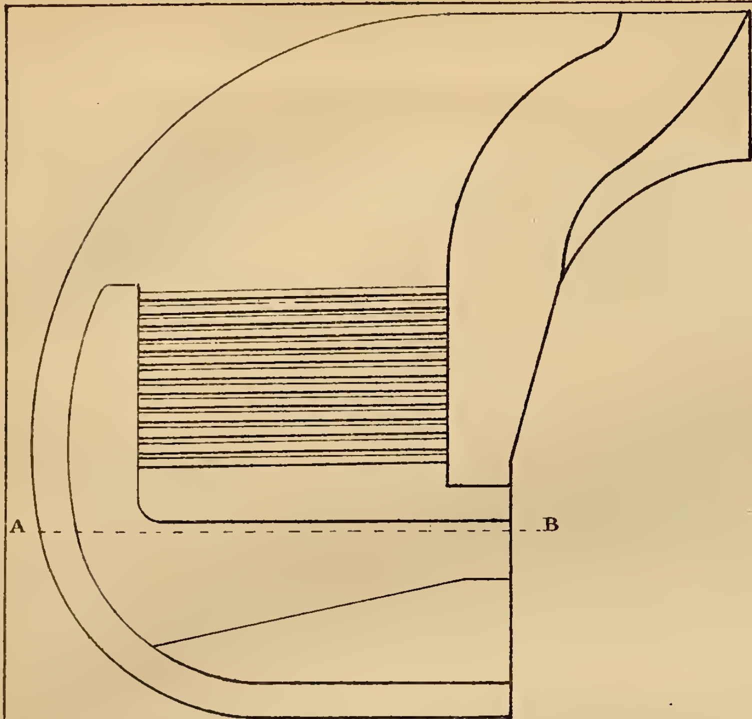
BURLEIGH'S PATENT CROSSING

AS ADAPTED TO THE DOUBLE-HEADED RAIL.

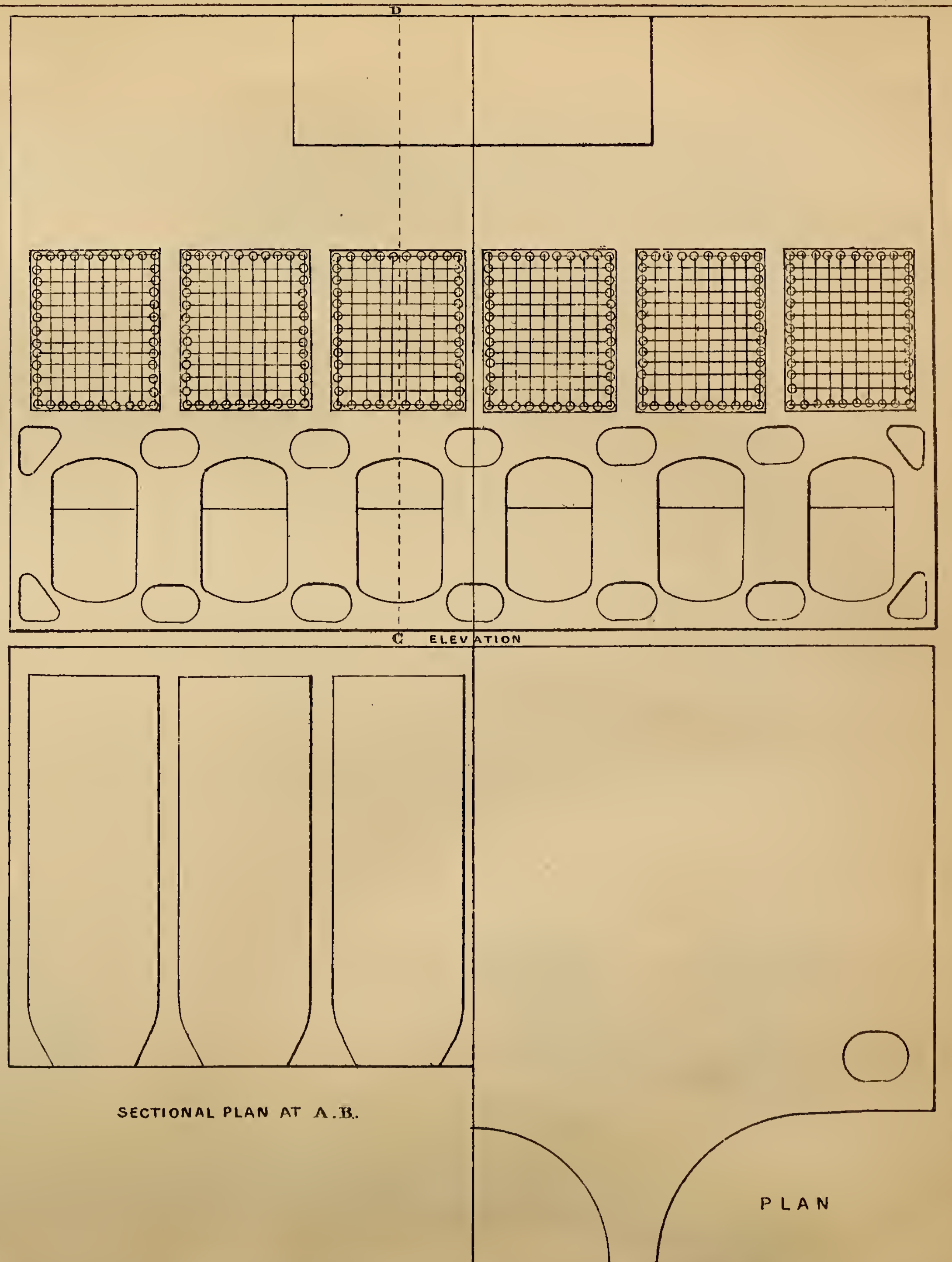


SECTION AT *B. B.* ¼ SIZE.

SECTION AT *D. D.* ¼ SIZE.



CROSS SECTION AT C. D.



SECTIONAL PLAN AT A.B.

PLAN

BOILERS

OF

HER MAJESTY'S NEW STEAM YACHT

VICTORIA & ALBERT.

BY JOHN PENN & SON.

1855.

SCALE, ¼ INCH TO A FOOT

THE ARTIZAN.

No. CL.—Vol. XIII.—JULY 1st, 1855.

DISC-ENGINE BOATS.

In the month of May, 1853, our attention was called to the performance of a small iron boat which had been fitted by Messrs. Rennie and Co. with disc-engines and screw-propellers for His Highness Said Pacha, now Governor of Egypt, as a pleasure-boat; and, as this boat was intended to ply occasionally on the Mammoudeh Canal and the Lake Menzaleh, as well as the Nile, one condition was, that the draught of water should not exceed 2 feet; the other, that the minimum speed should be 9 knots per hour. Under these circumstances, it became necessary to construct a boat of sufficient dimensions to carry engines of the lightest possible weight, and of sufficient power to propel the boat at that rate of speed. The disc-engine was therefore adopted on Messrs. Rennie's responsibility, and the success has been the most complete. The boat in question is of iron. Her dimensions are—

Length	60 feet
Width	6 „
Draught	22 inches

She has two disc-engines, of 13 inches diameter; two screw-propellers, one on each stern-quarter, of 2 feet diameter; and when tried on the River Thames, with a pressure of steam at 45 lbs., the screw-propellers made from 310 to 320 revolutions per minute, and the boat 10 knots per hour. This performance was exceeded when the boat was tried on the Nile by the Pacha himself, who increased the pressure to 60 lbs., and the speed to 12 knots per hour, thus beating the best paddle-boats on the Nile, and frequently making the voyage from Alexandria to Cairo, a distance of 200 miles, in 20 hours. On one occasion she towed a loaded barge of 80 tons at from 4 to 5 knots per hour.

Shortly after the boat was sent away, a small iron boat, of 33 feet in length and 4 feet in width, was made by Messrs. Rennie, with one small disc of 10 inches diameter, for a private gentleman, who made the voyage in her from Folkestone to Boulogne in less than six hours.

In the year 1854, a third boat was built and fitted by Messrs. Rennie for a few gentlemen, for running as a passage-boat on the Cochrane Canal, near Madras. The dimensions of this boat were—

Length	70 feet
Breadth	7 „
Draught	16 inches

This boat was fitted with two 13-inch disc-engines and screws, as the Pacha's boat. Her speed, when tried on the Thames, was 10 knots an hour. The following experiments were made, by a party on the Grand Junction and other canals, for the purpose of ascertaining the applicability of towing to canals, previous to her being sent to India.

July, 1854.

PARTICULARS OF A VOYAGE FROM THE CITY BASIN, LONDON, TO MANCHESTER.

Mr. Rennie's steam-boat, laden with ballast and goods, about 4 tons, and taking in tow the fly-boat *Stockport*, laden with 15½ tons of goods. Total weight moved, 24 tons; 253½ miles, and 169 locks.

Date.	Canals.	Length. Miles.	Locks. No.	Time occupied Hrs.	Time occupied Min.	Stoppages. Hrs.	Stoppages. Min.
June 23	Regent's	4	5	2	31	0	0
„ 25	Grand Junction	100¾	90	44	51	1	5
„ 26	Oxford	23⅓	3	14	28	5	0
„ „	Coventry	21¼	13	9	35	0	0
„ „	Old Birmingham	5½	0	2	15	0	0
„ „	Coventry	5½	0	1	20	0	0
„ 28	Trent and Mersey	67	58	38	5	6	10
„ „	Duke's	26	0	7	29	0	0
		253⅓	169	120	34	12	15
Deduct stoppages without locks, 5″ per lock				12	15		
Time occupied				108	19		
Ditto passing locks				14	0		
Actual time going				94	19 going 253⅓ miles.		

Observations:—

		Hrs.	Min.
The stoppages were:	To change screws	1	5
	Breakage, chimney and boiler choked	5	0
	Boiler choked	6	10

Coals consumed—*Welsh coals* throughout the voyage, estimated at 5 tons, which cost £1 7s. 6d. per ton at City Basin.

The time-bill allows 98 hours and 35 minutes for the journey with horses, but it is not performed within that time in ordinary practice, and never with a boat laden with 15½ tons: 12½ tons is an average load for a Manchester fly-boat to carry, when towed by horses.

July, 1854.

PARTICULARS OF A VOYAGE RETURNING FROM MANCHESTER TO THE CITY BASIN, LONDON.

Mr. Rennie's steam-boat, laden with goods and ballast, about 2 tons 4 cwt., and taking in tow the fly-boat *Stockport*, laden with 10 tons of goods.

Date	Canal	Hrs.	Min.	
July 4	Duke's Canal	5	30	
„ 6	Trent and Mersey	34	41	stopped
„ „	Coventry	1	21	4 hours and 50 min.
„ „	Old Birmingham	2	27	by hindrance
„ „	Coventry	8	27	at tunnel
„ 7	Oxford	9	14	and loss of rudder
„ 8	Grand Junction	37	51	
„ „	Regent's	1	43	
		101	14	
	Deduct stoppages	4	50	
	Time occupied	96	24	
	Deduct for locks	14	0	
		82	24	going 253⅓ miles

Observations:—

Exclusive of the above stoppages of 4 hours 50 minutes, we stopped six times to purchase and take in coals, and which did not occur on the down-trip.

The coals consumed were 5 tons 17 cwt. and 2 qrs. of different qualities, costing £4 17s. 10d., as picked up at wharfs, from 7s. to 30s. per ton.

1 ton of Harecastle coals lasted 29 hours.

1 ton of Warwickshire coals lasted 12 hours.

On the return journey we used the 3-bladed screw.

From experiments made with a wider screw—two blades—it would appear that much less steam would be required, the engines going the same speed at 160 revolutions as at 320 revolutions, with the finer-bladed screw.

TRIAL WITH THE ABOVE BOAT ON THE COCHRANE CANAL.
(From the "Overland Athenæum.")

"*Madras, 29th April*, 1855.

"AN EVENT.

"On Saturday last a start was made in the endeavour to relieve the capital of Southern India from the effects of that dull apathy and indifference to progress which have unfortunately characterised this presidency hitherto; and small as is the scale of the experiment, we yet deem it worthy of notice, as being the first practical attempt to extend the means of locomotion round by Madras in a way which will prove of the greatest value to the country.

"For some time past arrangements have been in progress to start a small steamer on the extensive inland water existing in the vicinity of Madras, and a little vessel having been recently obtained from Messrs. George Rennie and Sons, of London, the shareholders took the opportunity of the visit of Lord Harris on Saturday, to the canal basin, for the purpose of inspecting the steamer to float her out of the dock; Lord Harris having, with his usual consideration for the feelings and wishes of all classes, consented to witness the ceremony.

"Through the kindness of Major Jenkins, the Madras railway agent, the willing and invaluable assistance of Mr. Kennedy had been given; indeed, the railway engineers, one and all, have most handsomely aided Mr. Myers in this our attempt at fitting out an iron steamer.

"A tent was fixed for the accommodation of the more distinguished visitors, and the scene was enlivened by the attendance of the garrison band; Miss Ross, the graceful daughter of one of the most active members of the Provisional Committee, having kindly consented to perform the ceremony of naming the vessel. The breaking of the bottle on the steamer's bows was most successfully performed, and the *Bawnum* (the *Rocket*) floated out of dock into the canal in perfect order in the presence of a large concourse of spectators; and the most pleasing feature was, that those who took the most prominent part in the business were gentlemen who, being connected with this country by birth and position, are those amongst whom the raising a spirit of enterprise is the most important and desirable.

"A considerable party, including Lord Harris and staff, having then embarked, the *Bawnum* was brought down in the water to greater depth than with the tonnage justified, or the depth of the canal warranted; and still, with all the disadvantages of putting on steam for the first time, with engines not previously tried, and constructed on a principle not yet in general use, the little vessel made fair away up the canal, having two heavy boats in tow; and after passing the railway bridge, she was turned in her own length and steamed back to her place of departure, where the company disembarked without other *contre-temps* or inconvenience than being covered with showers of black from the engine; a misadventure on which we must condole with the ladies present, but which will not be likely to recur when once the engines are in full use, and when clear water is available, instead of the muddy fluid now filling the canal. The importance of the results to be looked for from this experiment must not be judged from the working alone of the first small steamer, which ought to be viewed rather as the pilot-engine on a railway sent forward to see that the way is clear for large trains to follow, than as an independent concern.

"We subjoin, for the benefit of those who are curious in such matters, some particulars regarding the steamer.

"PRINCIPAL DIMENSIONS OF THE NEW SCREW-STEAMER 'BAWNUM,' ON COCHRANE'S CANAL, MADRAS.

	Ft.	In.
"Length extreme	70	3
Breadth	7	0
Depth	3	6
Length for tonnage	68	6
Tonnage, O. M. 10 tons $\frac{7}{94}$		
Diameter of cylinders, each	0	13
Crank-lever		9
Diameter of screw-propeller, each, 2 blades only	2	0
Pitch of ditto	2	3

"This is among the first applications of this kind of engine to the screw-propeller. It admits of being directly applied to the screw-propeller shaft, requiring no intermediate wheel-work. The engines are exceedingly simple and compact, occupying only 2 feet in the length of the steamer. The mode of working the engines is very simple, admitting of reversing either both or one of working them in opposite directions at the same time.

	Forward. "	Aft. "
"Draught of water light	10	16
Ditto loaded for towing	15	21

Speed when light	10 knots per hour
Ditto when towing ten boats of 25 tons each	2 knots per hour
Consumption of coal	1 cwt. per hour
Cost of haulage	1 pice per ton per mile, or $\frac{1}{8}$th of a penny.

"Calculating for 200 tons, and allowing rupees 25 a ton for coals, and, further, the very high rate—viz., 600 rupees per month, to cover all other charges.

"This steamer is a beautiful model, having very fine lines, is very easily steered, and is constructed entirely of iron.

"It was brought from England in four pieces, which have been framed together, and the engine and boiler fixed in their places in a temporary dock excavated by the side of the canal for the purpose. The whole cost, including all charges of freight, landing, and fitting up here, may be calculated at about 11,000 rupees.

"We understand that in a few days the steamer proceeds with a small party to have her engines adjusted and put into thorough working order, stopping at Pulicat to breakfast, and proceed up the lake Cos, returning to Madras in the evening.

"CANAL.

"The canal known as Cochrane's, or Centapilly canal, connects Madras with the Pulicat lake, extending over a basin of 300 square miles, and by various channels navigation is extended as far as Sooloorpett and Doogeuzapatam, that is, a distance of 60 miles from Madras, and within 30 miles of Nellore.

"This noble project conceived by Lord Harris for the formation of a canal extending from the northern extremity of the Madras presidency down to near Point Calymere, a distance of 1,000 miles; and on this grand line, when ready, steamers will ply of such burden, description, and number, as will be in keeping with a line of navigation surpassing in magnitude any one yet known in the world."

The Pulicat lake is a backwater or lagune to the northward of Madras. It is about 50 miles in length, north and south, and about 15 miles broad, east and west, in the widest part; and its southern extremity is about 20 miles from Madras. The boats which ply between Madras and the northern parts of the Pulicat lake are called Northern boats. The largest of these are 50 feet in length, $12\frac{1}{2}$ feet in breadth, draw $2\frac{1}{2}$ feet water, and carry 15 tons; and the smallest boats carry 5 tons: they are about 270 in number. There is also a smaller class of boat rowed at Pulicat, called Top-boats. These are used chiefly for the conveyance of passengers, being furnished with a *top* or awning. There are about fifty in use constantly. There are also a few boats called Badge-row, provided with cabins for richer people. The largest boats draw $2\frac{1}{2}$ feet water.

The canal was originally 20 yards wide. The boats are towed by men: great difficulty in two boats passing.

The Cochrane canal is the first attempt made to introduce canal navigation into the Madras presidency, and with eminent success. On the Godavery canal the cost of conveying cotton would be two pice per ton per mile, or the cost of carriage would be reduced one-fourth its present cost.

In the year 1853, a disc-engine of 13 inches diameter was ordered from Messrs. Rennie by the Russian Government, and was afterwards fitted in a small gun-boat of 56 feet in length and 9 feet in width. The boat had previously been fitted with one of Capt. Fitzmaurice's engines, and failed; but on applying the small disc to the old boiler which remained in the boat, the speed attained was 7 knots per hour, to the great satisfaction of the Grand Duke Constantine and the Russian Board of Admiralty. The success of the boat would have led to the ordering of others, but was put a stop to by the war. The application of the disc-engine to gun-boats and ships' launches would have admirably suited the emergency of the English Navy in the shallow waters of the Gulf of Finland and the Sea of Azoff.

All the above disc-engines were according to Mr. Bishop's patent, and fitted under that gentleman's direction for Messrs. Rennie.

OPENING OF THE SOUTH INLET GRAVING DOCK AT H. M. DOCKYARD, PORTSMOUTH.

We have watched, during the past few years, with much interest the working out of a great problem, namely, whether the peace of Europe and the world was not more likely to remain undisturbed by keeping up our Navy and Army, our naval arsenals, and other such establishments, to such a point of efficiency and in such a condition, that we could command our position, and be at all times prepared, as befits a nation, with the immense resources which our advancement in science and the arts has placed in our hands; or whether the nations should yield to, and be governed by, a class of sickly sentimentalists, who arrogate to themselves the claim of being the only friends of peace.

This class, by their frothy and noisy demonstration, have had such a chilling influence on the Executive for many years past, that now, when the nation is fully aroused to the absurdity and hollowness of such pretensions and false economy, and the Utopian theories *of peace*, the nation finds that the price which it has paid for such theories is, its being involved in a European war, which looks dark and lowering in the future, and the national arsenals found to be "not *big* enough for the *times*."

We have been led into these remarks by the activity which now pervades all our public establishments, and we do hope that those who have the responsibility will not hold back, nor slacken in their exertions, till we are in every way prepared for any emergency. By way of illustration, we may state that the Admiralty found themselves, during the past year, in possession of vessels, without the means of docking them. The *Himalaya* had to be sent to Southampton to be docked, in consequence of her great length. Again, the new yacht *Victoria and Albert* has been waiting to be docked these last few months, from the same cause, till, on Tuesday, the 12th of June, the South Inlet Graving Dock in Portsmouth Yard was formally opened, in the presence of the chief officers of the various departments, and a large assemblage of spectators, who appeared highly gratified to see the completion of so important an undertaking, and so valuable an addition to our national resources.

We are glad to be able to add, that the *Victoria and Albert* yacht was warped in, the caisson put into its place, and everything passed off in the most satisfactory manner, reflecting the greatest credit on all concerned.

The dock is a splendid specimen of work, being a part or extension of the Steam Basin Works which have been in course of construction, by Mr. Edmund Smith, contractor, during the last ten years.

The following are a few of the principal dimensions and facts relating to the dock :—

	ft.	in.
Extreme length	335	0
Length of the floor	302	0
Extreme breadth	80	9
Extreme depth	29	0
Depth of water at spring-tides	23	0
Width at entrance	70	0

The following quantities of materials have been used in its construction :—

About 3,000,000 bricks.
" 152,359 cubic feet of stone.
" 94,783 " " timber.
" 729 cwt. of iron.

We have much pleasure in being able to promise our readers that, next month, we shall give one or two plates illustrating this noble dock—namely, a transverse section, a plan, and a longitudinal elevation, with all details, estimated cost, &c.

We have also much pleasure in being able to give illustrations of the caisson for closing the entrance to this dock, which was designed by Henry Wood, Esq., the Clerk of Works of H. M. Dockyard, Portsmouth. Having had the pleasure of closely inspecting it, we are bound to say that, in design and in execution, it reflects the highest credit on Mr. Woods, the designer, and Messrs. Mare and Co., of Blackwall, who constructed it; and we hope to be able to give at least one plate of it next month.

HER MAJESTY'S NEW YACHT "VICTORIA AND ALBERT."

On looking over the "Navy List," the other day, we were very much struck with the fact that of all the vast naval armament now in course of construction, only *one* paddle-wheel vessel appears in that list, all the others being screws.

As it—the Royal yacht—may be the last of the *paddle* race in the Royal Navy, we have much pleasure in being able to give our readers the following particulars of this vessel.

The makers of the machinery are the Messrs. John Penn and Son, and from the high standing of this firm as marine engineers, we fully expect that this last example of the *paddle*, constructed for great speed, with all the necessary qualities of compactness and strength combined with lightness,—we say we fully expect that the machinery of this vessel will embody all the experience in marine engineering during the last thirty years, and prove highly creditable to the constructors.

We have much pleasure in presenting to our readers (Plate xlvii.) an illustration of one piece of the Royal yacht's boilers. There are four of these pieces, two placed before and two abaft the engines, with a funnel to each pair of boilers, and the stoke-hold amidships. The following are a few of the principal dimensions of the boilers.

Length of tubes (brass ferruled)	6′ 5″
Diameter of ditto	2½
Internal diameter of ferrules	2
Number of tubes in the four boilers	3.024
Total fire-grate surface	504 sq. ft.=84 per H. P.
Total heating surface in flues and tubes	14,050 sq. ft.=23·4 per H.P.
Area through tubes	9,493 sq. in.=15.8 per H.P.
Pressure on the safety-valve	20 lbs. on the square inch.

On carefully looking over the above figures, we cannot but be struck with the very much more common-sense view taken by our engineers now-a-days.

We have often regretted to see, as we have often seen, vessels loaded with *large engines*, and on making the inquiry, "Have you plenty of steam?" "No," was the usual reply, and it is too often so still that the answer is, "*No, we are short of steam.*" And it cannot be denied, that the boiler, as the source of power is too often lost sight of. This, however, cannot be said of the boilers of the Royal yacht.

The following are a few dimensions of the engines :—

Nominal horse-power	600 horses.
Diameter of cylinder (vibrating)	88 inches.
Length of stroke	7 feet.

The paddle-wheels are feathering and overhung, the outer bearing being supported on the ship side : each wheel weighs about 50 tons.

Diameter of wheel	31 feet,
Number of floats	14 in each wheel.
Size of floats	11′ 6″ long × 5′ 1½″ broad.

The vessel was designed in the Surveyor of the Navy's Office, and built at Pembroke Yard. As we saw her the other day, in the dock at Portsmouth, she looked a splendid specimen of modern naval architecture; her internal fittings and accommodation are in every way worthy of our beloved Sovereign, and an honour to the nation. It is expected that she will steam at about 16 knots per hour.

The following are a few of the principal dimensions of the vessel :—

Length between the perpendiculars	300 feet.
Breadth, extreme	40′ 3″
Mean draught of water	15′ 0″
Tonnage, builders' old measurement	2,342 tons.

THE FRENCH STEAM FLOATING BATTERIES.

Our Floating Batteries are said to have been built from French designs; at least, all the defects of those monstrous engines of warfare are charged to French account.

We propose next month, if possible, to give plans and particulars of the French batteries, if our illustration can be completed in time. We have, however, lately had several inquiries addressed to us respecting the French batteries, and therefore give the following short statement of dimensions, &c. :—

These formidable war-machines are built of timber, but lined externally from the gunwale to light-load water-line with $4\frac{1}{2}$-inch wrought-iron plates, carefully planed on their edges and bolted through the sides of the vessel. Their length is 170 feet, and breadth 43 feet, armed with 16 guns for 50 lbs. solid shot. The displacement is equal to 1,400 tons, and the weight of iron plate 400 tons.

They will be worked by a crew of 200 men, and will each have in addition a force of 200 *infanterie de marine.*

They are bark-rigged, the mast being moveable, that they may be taken down before going into action. They are worked by a pair of high-pressure engines of 220-horse power collectively.

The boilers are horizontal, of a total length of 17 feet $7\frac{1}{2}$ inches; the tubes, 9 feet $5\frac{1}{2}$ inches long; the fire-bars, about 7 feet long by 3 feet 9 inches wide. The form and arrangement of these boilers are shown by the accompanying illustrations, Figs. 1, 2, 3, and 4.

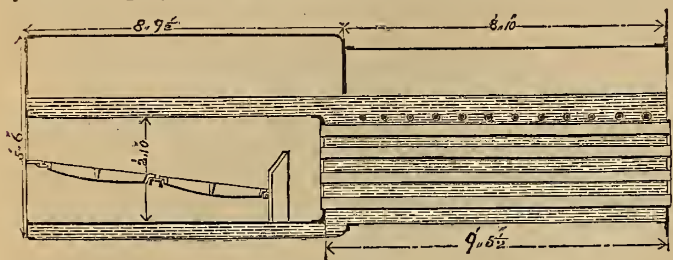


Fig. 1.—Elevation.

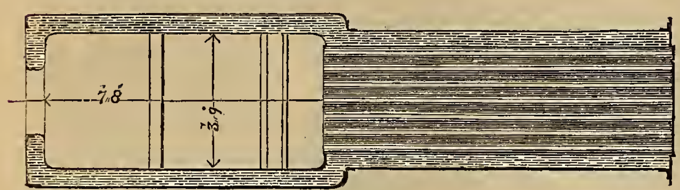


Fig. 2.—Plan.

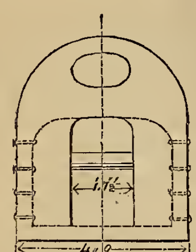


Fig. 3.—End View.

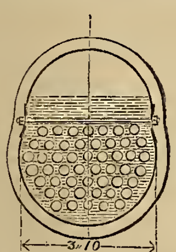


Fig. 4.—Section through Tubes.

There are six of these boilers in each battery: the pressure of steam at which they are worked is 60 lbs. per square inch.

The accounts we have received of the performance of the engines and machinery, and more particularly the speed of the vessels through the water, are far from being satisfactory.

WHAT'S TO BE DONE WITH THE FLOATING BATTERIES?

Of the Floating Batteries we scarcely have patience to say another word, they are such an irremediable blunder. Hitherto, we have been unwilling to join in the terms of unqualified disapproval which have been universally launched against them, under the supposition and hope that some of their defects might be brought within the limits of redemption, and that their completion might probably develop some good features which could not be foreseen; but no such thing—though they have been altered, re-altered, and altered again, they exhibit not the slightest symptom of improvement. Their rig has gone through the usual series of transformations, and though apparently conclusively finished at last with a fore-and-aft rig, at the last moment two yards have been added to the fore-mast (their port-sills will soon be at the water's edge; indeed, they do not appear to be more than three feet out of it now, without their armament, iron plates for the upper deck, provisions, or fuel, on board); but the yards are required to enable them to spread more canvass, and give the rudder some command of them. Will it be believed, that in the last trial of the *Glatton*, the thing swung round like a washing-tub? Nay, so thoroughly uncontrollable are they, that notwithstanding all the steam and sail power they could put upon the *Glatton*, it is the general belief that the thing would have drifted on shore, had it not been for the steam-tug in attendance. A case so hopeless, after the expectations we had formed of them, and after the thousands which have been, and will still be, spent upon things so worthless, is too much for flesh and blood to look upon with indifference; it is really beyond the limits of human endurance. Their naval architecture is bad, their rig we consider ought to have been unnecessary—at least, easily removable; and against the blundering and experimenting in the engineering department we must protest. They were constructed to receive one screw in the usual manner, but were afterwards altered to receive other two; now they are re-altered to the original number of screws, but with another screw of a greater pitch, and engineers cannot fail to perceive that matters must be worse than ever, since it is well known that a bluff-built vessel requires a finer pitched screw than a sharper one, and the result of the last alteration will be an increased expenditure of horse-power for the same speed as at first. But the manner in which the two additional screws were applied calls forth special condemnation, and which we will endeavour to describe. The centres of all three screws were on the same horizontal plane, but the two side screws were in a vertical plane ahead of the central one, and their centres such a distance apart that the discs described by the side screws intersected that described by the centre screw, so that there were two considerable portions deducted from the propelling area of the centre screw. It is clear that the centre screw, under such circumstances, could do little more than merely turn and splash among the water already put in motion by the screws ahead of it. These batteries ought to have been prepared in the very first case to receive at least two screws; and why the two side screws are now taken away, after going to such an expense, instead of merely unshipping the centre one, we are at a loss to conceive. The latter alteration would have secured at least double their present propelling area, at one tithe the expense.

Here have been some thousands of pounds expended in mere alterations of machinery, and for what?—nought, if we exclude the fact of their final screw being a cast-iron one in preference to gun-metal—ashamed, we presume, of the expenses already incurred. How long the cast-iron one will last, we leave others to guess. And yet, we could forget all this, if we could see the slightest chance of the things being able to do their work. Their port-sills are so near the water, and will be so close when they are fully armed, manned, and equipped, that they cannot possibly be used excepting in a dead calm. Why was their fighting-deck placed so near the water-line? Allowing a fair margin for errors of calculation, why was their other deck made so low, that a man 5 feet 10 inches high cannot walk upright without danger of dashing his brains out? Why were they made incapable of being sailed, steamed, and steered, when it was intended to sail, steam, and steer them? We could multiply these queries, but we grow sick in attempting to enumerate the hideous blunders which have been perpetrated over these batteries. The best season, too, for active operations in the Baltic is fast passing away, while the precious time is being humbugged away in the Royal dockyards in making profitless alterations. In fact, considering that the opinion is very generally entertained that they will never be able to get across the German Ocean—that no one has the slightest confidence in their fitness for the work—that the season in the Baltic will probably be too far advanced to admit of their doing much good by the time they get there, if they can—and, finally, that as they are an object of contempt to all, from Jack upwards—we would humbly suggest whether it is not worth a consideration to break up the present floating batteries, building new ones, using up as much as possible of the old materials, and correcting all previous errors.

NASMYTH'S MONSTER GUNS.

It is very much to be feared that the Nasmyth monster guns will, after all, turn out to be monstrous blunders; not from any defect in the manufacture or proportions of the guns themselves, but from the bad and irregular manner in which they are mounted: we say irregular, because they are mounted in defiance of the first principles which should ever be present to the scientific artillerist. Their fittings are not sufficiently advanced to enable us to speak of every detail, but we possess sufficient information to enable us to discuss the propriety or impropriety of mounting guns as Mr. Nasmyth is projecting, and which is as follows:—The guns have two pairs of trunnions, one pair in the usual position and another pair at the breech; there are two bearings in the cheeks of the gun-carriage to receive gudgeons, and the gun is slung from these by means of two pairs of suspending links taking hold of the trunnions, after the manner of Captain Julius Roberts' mortars—but with this important difference, that while Captain Roberts' mortars are free to oscillate as a means of recoil, Nasmyth's guns are slung at a permanent and unalterable angle in a carriage which will not recoil, being fixed on a turn-table platform, as in Captain Roberts' system of mounting mortars; and when we announce that the angle which the gun makes with the horizon is about 20°, and that there is no provision for a horizontal recoil, the seriousness of the blunder will, we are sure, be admitted and regretted. We do not for a moment accuse that engineer of entertaining the vulgar opinion that a gun will range farther on the non-recoil than on the recoil principle; but we cannot conceive what could have induced him to mount his guns in such a manner. There is no command of the range but by varying the charge of powder—an old, uncertain, and blundering practice, and it cannot for a moment be supposed that they will remain quiescent under a charge which is in the usual proportion to their own weight, if not more: in fact, the result will be precisely what it has been in the mortar practice in some of the trenches before Sebastopol. Officers who have returned from the Crimea inform us that they have had to remount their mortars after every discharge, in consequence of there being no horizontal recoil, and the elasticity of the platform allowing sufficient vertical recoil to pitch the mortar head-over-heels, and sometimes throwing it off the platform entirely; and such will, no doubt, be the result with Nasmyth's guns, where the elastic cushion underneath the carriage will give sufficient vertical recoil to pitch the gun over, or make it so unsteady under fire as to render it practically useless. We, therefore, do not expect any very brilliant results from the Nasmyth guns: had they been mounted on good principles, the matter would have stood differently; but everything seems to conspire to nullify their utility in the present campaign, and to prevent them offering testimony to the capabilities of heavy wrought-iron ordnance—badly mounted on board a vessel, the *Horatio*, whose draught is too great to enable them to be brought to bear upon the places where their services are most required.

CAPTAIN JULIUS ROBERTS' SEA-SERVICE MORTARS.

The improvements in mounting mortars which have been effected by Captain Julius Roberts, of the Royal Marine Artillery, will probably form an era in the working of this kind of ordnance. To fully comprehend the advantages which these improvements will afford, it will be necessary to observe that in the old system of mounting mortars there is not, and cannot be, any appreciable recoil, the cradle of the mortar being placed on a comparatively inelastic bed of stone or wood, the mortar being reared up at an angle of 45°, and kept in that position by a large quoin, while the differences of range are regulated by the charge of powder quantitatively. Now, though Captain Roberts regulates his differences of range in the same manner as in the old system (which we consider to be primitive and defective), there is this important difference, that the mortar is free to recoil with respect to the force of the recoil resolved horizontally, while the vertical force is received by a series of india-rubber rings. Having recently had an opportunity of inspecting some of the sea-service mortar-vessels in which these mortars are mounted, a few particulars of their construction will probably be found interesting.

In about the centre of the deck, a circular recess is formed to admit the lower part of the carriage of the mortar; and between the bottom of this recess and the under side of the carriage is interposed a series of india-rubber rings, forming an elastic cushion eight inches thick. On the top of this cushion a ring of cast-iron is placed, and bolted down through the india-rubber to the wood-work, another corresponding ring of gun-metal being fixed to the under side of the carriage. These rings are to enable the carriage to be swivelled round, and direct the mortar into any azimuth, any friction against the sides of the recess being prevented by a series of friction-rollers let into the sides, and bearing against the edge of the carriage. The mortar is suspended or slung in the following manner:—from the lower or turn-table part of the carriage, rise two strong wooden frames, or cheeks, of a somewhat trapezoidal form, and supporting a large wrought-iron gudgeon, just as the sides of a carriage would receive the trunnions of a gun. From this gudgeon two strong wrought-iron links descend and clip the trunnions of the mortar, and support its weight; whilst it is held at an angle of 45° by an iron strap passing round the muzzle of the mortar, and fixed to the suspending links. To prevent any straining of these parts, a friction-pulley is attached to each link, with a corresponding curb of gun-metal let into the frame. To facilitate the slinging in of the shells, a small davit is attached to one of the frames, which will save much laborious trouble. For turning the whole apparatus, an instrument somewhat similar to a tiller is prepared, and made to ship and unship as required.

Returning now to the principle involved in this mode of mounting mortars. It cannot fail to strike the student in gunnery, that their action on the explosion of the charge will be precisely similar to that of Dr. Hutton's *éprouvette* and the gun pendulum, as used in France and America to determine the initial velocities of shot and other matters relating to the science of gunnery. The mortar being free to vibrate, and slung at an angle of 45°, the force of the recoil will resolve itself horizontally, and give a pendulous motion to the mortar, by which the unsteady effects of the discharge are avoided, while the vertical part of the recoil will be received by the elastic cushion of india-rubber. It cannot fail to be perceived, the ease and precision with which these mortars may be worked: another such improvement, and then we would possess all the command with vertical fire which we now possess with the horizontal; another improvement to enable the mortar to be set at any necessary angle, so as to command any range within certain limits with a given quantity of powder, and mortar practice might then be carried on with scientific accuracy, instead of the blundering and guessing work it has mostly hitherto been. The inventor, we presume, has been obliged to work up old mortars, or else work from the old patterns, and thereby had to sling the muzzles with an iron strap; for it is clear that an additional pair of trunnions at the muzzle would have been desirable, as the sling would then have more command of the mortar to keep it steady under fire; and, in fact, should it ever be deemed necessary to carry out the principle we have hinted at—that of having the angle of the mortar to vary, and not to depend upon the powder only for the range—a pair of extra trunnions will be necessary. However, for the improvements already made, infinite credit is due to Captain Julius Roberts, and we trust that he will continue his attention to the subject until the system which he has begun is as perfect as human efforts can make it. And, in the mean time, we trust that the Authorities will not be slow to appreciate the value of these inventions. Of the host of mortar-vessels which have been made, a portion only have them applied, the remainder being mounted on the old rigid plan. Inventions like this should be looked into and tried at once, instead of being staved off for years, and allowed to slip into the hands of foreign Governments. We therefore, hope the Authorities have ordered reports to be made on the behaviour of Captain Roberts' mortars in action; for, from what we learn, they appear to be as necessary—in fact, more so—in land operations as in marine. When mortars turn up head-over-heels, and roll off their platforms, as in the batteries before Sebastopol, it is high time something was done to put a stop to such blundering proceedings, when the remedy lies before us.

BURLEIGH'S PATENT RAILWAY CROSSING.

(Illustrated by Plate xlvi.)

Having already noticed that part of Mr. Burleigh's invention which has reference to the improvement of railway-switches, perhaps our readers will deem it desirable that we give also his patent crossing, and show the adaptation of the flange-bearer to both cases. In the case of the crossing, then, the flange-bearers E E (Plate xlvi.) are bars of wrought-iron fitted between the wing and point rails, with bolts passing through them and the rails, by which the whole of these are firmly bolted together, an iron wedge being inserted betwen the rails at the outer chairs of the crossing, the whole forming, as it were, a rigid girder. Fig. 1 is a plan; Fig. 2, a longitudinal section through the flange-bearer; and Figs. 3 and 4, sections at B B and D D respectively.

The object of the inventor, in introducing this flange-bearer, is to prevent the cutting action of the tyre when the wheel is passing from the wing to the point rail, where it must necessarily cross the wing-rail diagonally, and also to prevent the disagreeable jerking motion created by the wheel dropping into the space or recess which is soon formed between the wing and point rails; but whether Mr. Burleigh's plans are eligible for remedying these evils, experience alone must determine, and we have no doubt his position will enable him to command a fair trial for them. That this form of crossing will be strong and durable, infinitely more so than any we have yet seen, there cannot be a doubt; but we question whether the flange of the tyre, in its present form, would bear the work which would be thrown upon it; while its form is almost the very best for enabling it to cut its way into the flange-bearer, and so reproduce the original evil in a few months. However, we shall see.

MATHER'S EARTH-BORING MACHINERY.

We have great pleasure in being able to present our readers with an engraving (Plate xliv.) of Mr. Mather's very ingenious and particularly useful invention.

The paper read by Mr. Mather before the Society of Arts on the 30th May describes generally the arrangement and the action of the machine and tools, and our report of the paper read at that meeting (in the present number) will put our readers in possession of what was there stated; but the importance of this invention demands more special notice, as it is allowed that the advantages of large bore-holes are becoming more universally understood; and when, by the use of this invention, they can be obtained at a cost considerably below that of the present system of boring, the variety of purposes to which this invention will be applied, and wherein it will effect great improvement and economy, will be great.

For rapidly and economically determining the mineral value of properties—for trial-borings for railway works—for cheaply opening a water supply to towns—for the better ventilation of mines, and for various other equally useful purposes, this invention offers singular advantages; and the excellence and simplicity of its parts, the perfect control under which it can be worked, and the rapidity and economy with which it has performed the several bores made in various localities, satisfactorily prove that the machine is one of permanent and reliable construction, and fully equal to the purposes for which it was designed.

As the plate, with accurate details of the steam-cylinder, and the boring-head and shell-pump, which should have accompanied the present notice, cannot be completed in time, we must postpone until next month the remainder of the notice of this ingenious contrivance.

AMERICAN NOTES.—No. VII.

STEAMERS.

Vanderbilt's Line.—The steamer building by C. Vanderbilt, Esq., for his new line from hence to Liverpool, is in rapid progress of construction. Three-fourths of her frame are up, and her engines and boilers are being built with all practicable despatch.

Collins Line.—The keel-blocks for this vessel are being laid at the new ship-yard of Mr. George Steers, formerly one of the two occupied by Messrs. Westervelt and Sons. Mr. Steers has finished her model, and is to be her constructor. Her dimensions are not as yet publicly made known. Her engines are to be fitted with surface condensers of Mr. William Sewell's arrangement.

New York and Havre Line.—The new steamer *Arago* made a satisfactory trial-trip on Saturday last, the 26th ultimo, and she will leave here on the 2nd inst. upon her first trip. Her engines are fitted with surface condensers, constructed under the patent of J. P. Pirsson.

The "Ericsson."—The great feature of the day in marine engineering is the performance of this vessel compared with her consumption of fuel. On the 28th ultimo she went to sea upon a trial-trip for the purpose of noting her exact consumption of fuel, the particulars of which trial and its results are given in the following report of Mr. Haswell, under whose direction the trial was carried out. Her fresh-water condensers not only worked well for the particular purpose of condensation of the steam for the engines, but, by the aid of a distilling apparatus, all losses of water by leaks, &c., were amply supplied; added to which, by the addition of an independent vessel, the escape steam from the boilers is passed through it and condensed, even whilst the wheel-engines are stopped. The whole arrangement is the invention of Captain Ericsson. In order to meet the doubts of some as to the truth of so great an evaporation as is declared to have been effected in this report, it is proper to add that the steam-chimneys of this vessel are no less than 12 feet in height; that the steam therein becomes slightly surcharged; that the boilers, steam-chimneys, and steam-pipes are coated with felt and canvass to an extent that reduces the loss by radiation of their heat to an extent never yet attained here; and that the liberating surface of the water in her boilers is so quiescent as to furnish steam alone to the engines, and not, as in a large majority of cases, a commixture of water and steam:—

DIMENSIONS OF STEAMER "ERICSSON."

Hull built by Penni, Patterson and Stack, New York; Engines by Hogg and Delamater, ditto.

Length on deck	250 ft.	0 in.
Breadth of beam	40	0
Depth of hold	19	4
Depth to open deck	27	0

Length of engine space in lower hold, 65 by 18 feet; between decks, 35 by 18 feet.

Tons, 1,903.

Kind of engines, inclined direct-action; do. boilers, vertical tubular; diameter of cylinders, 62 inches; length of stroke, 7 feet 8 inches; diameter of paddle-wheel over boards, 32 feet; length of boards, 10 feet; depth of do., 1 foot 4 inches; number of do., 32 feet; number of boilers, 2; length of do., 16 feet; breadth of do., 14 feet 6 inches; height of do., exclusive of steam-chests, 12 feet; number of furnaces in each boiler, 6; breadth of do., 3 feet; length of fire-bars, 5 feet; number of tubes in each boiler, 845; internal diameter of do., 1¾ to 2¼ inches; length of do., 4 feet 10 inches; diameter of chimneys (four), 3 feet 1 inch; height of do. above main deck, 16 feet; load on safety-valve in lbs. per square inch, 25 lbs.; area of immersed section at 17 feet draught of water, 546 square feet; contents of bunkers in tons, 500; consumption of coals per hour, ·85 tons; date of trial, 28th and 29th May, 1855; draft forward, 16 feet 10 inches; do. aft, 17 feet 2 inches; average revolutions, 13⅝; speed in knots, 11; weight of boilers without water, 134,276 lbs.; heating surface, 7,000 square feet; has fresh-water condensers to engines; combustion, natural draught. Rig, brig. Intended service, New York to Havre. Classed in New York, Class 1, A 1. Floor timbers, moulded, 20 inches; do. sided, 20 inches; frames apart at centres, 30 inches. Hull shipped with diagonal and double-laid iron braces 4½ by ⅝ inches, 2½ feet apart. Floors filled in solid. Water-ways on three decks.

New York, May 30th, 1855.

Dear Sir,—Having, in compliance with your request, embarked on board the steamer *Ericsson*, on the 28th inst., for the purpose of witnessing the performance of her machinery, and having received authority from you to control the operations of it in such a manner as I saw fit for the purpose of advising myself of the consumption of fuel in her furnaces, speed of vessel, &c., I have now to submit to you the following report of my observations; and, for the purposes of ready comparison and estimate of the value of the elements submitted, I give the following particulars of hull and machinery :—

HULL.

Length on deck	250 ft.
Breadth of beam	40
Depth of hold	27

Draught of Water.—Forward, 17 feet 2 inches; aft, 16 feet 10 inches (mean, 17 feet).

Coal and water on board, 550 tons. Area of immersed midship section at this draught, 546 square feet.

Machinery.—Two inclined engines, of direct action.

Cylinders.—62 inches in diameter by 7 feet 8 inches stroke of piston.

Water-wheels.—32 feet in diameter by 10 feet in width.

Boilers.—Two vertical tubular, supplied by fresh water from the external condensation of the steam. Natural draught to furnaces.

Cut-off.—Drop-valve, with adjustable arrangement, set in this experiment at $\frac{45}{100}$ths of the stroke of piston.

Dip of Water-wheel Blades.—4 feet 6 inches.

Coal.—Anthracite (Pittston); bituminous (Cumberland).

RESULTS OF EXPERIMENT.

1st. *Anthracite.*—At Sea, May 28th, 1·45 P.M. to 2·15 A.M. 29th, 12 hours and 30 minutes : consumed 26,400 lbs., = 2,112 lbs. per hour, or ·94 of a ton (of 2,240 lbs.) per hour.

2nd. *Bituminous.*—At Sea, May 29th, 2·15 to 11·30 A.M., 9 hours and 15 minutes : consumed 15,390 lbs., = 1,664 lbs. per hour, or ·74 of a ton per hour.

3rd. *Anthracite.*—At Sea, May 29th, 11·30 A.M. to 1·45 P.M., 2 hours and 15 minutes : consumed 4,320 lbs., = 1,920 lbs. per hour, or ·85 of a ton per hour.

RECAPITULATION.

1st.	12h. 30m.	× 2,112 lbs.	=	26,400 lbs.
2nd.	9h. 15m.	× 1,664 lbs.	=	15,392 lbs.
3rd.	2h. 15m.	× 1,920 lbs.	=	4,320 lbs.
	24h. 00m.			46,112 lbs.

The total consumption for 24 hours = 20·58 tons.

The average pressure of the steam was $22\frac{3}{4}$ lbs. per square inch, the vacuum $27\frac{1}{2}$ inches, and the average revolutions of the engines $13\frac{3}{8}$ per minute.

The speed of the vessel, as measured by a chip log with 25 fathoms of stray line, was 11 knots large, = 12·83 statute miles per hour. The fresh-water condensers maintained a uniform vacuum of $27\frac{1}{2}$ inches of a mercurial column; and, by aid of an auxiliary distilling vessel, more water was readily obtained than was required to meet the loss by vents and leaks from the boilers, pipes, &c. &c.

With a view to test the evaporative qualities of the boilers, and at the same time to verify the extraordinary results here given in economy of combustion, the water of condensation therefrom was at six different periods measured in a vessel, and the supply was found to reach the unexampled quantity of 9·96 lbs. per pound of anthracite coal consumed; and notwithstanding this unprecedented attainment in a marine engine, it could have been very materially increased with better firing of the furnaces.

In conclusion, it may not be amiss for me to add, that all the elements of means and results here given were noted by myself so far as it was practicable for me to do so; and such as I had to transfer to the observation of others were alone confided to my two assistants, who accompanied me on this occasion for such service.

I am, respectfully, yours, &c.,

CHARLES H. HASWELL.

John B. Kitching, Esq., New York.

BRASS BOILER TUBES.—The following data, from high authority, furnish elements regarding the use of these tubes for marine-boilers of no ordinary interest.

Brass tubes in use 108 days lost $\frac{1}{16}$ of their weight, and the surface nearest the fire was fully one-half expended; and the character of the surface left no doubt that the fire destroyed the zinc of the composition. Observations had concurrent with and subsequent to the above would seem to authorise the opinion that the copper tubes rolled from plates and lap-welded would not present the objections here given.

DIMENSIONS OF STEAMER "ARAGO."

Hull built by J. Westervelt and Sons, New York; Machinery built by Stillman, Allen, and Co., ditto.

Length on deck from fore-part of stem to after-part of stern-post above the spar-deck	283 ft.	0 in.
Breadth of beam at midship section (moulded)...	39	3
Depth of hold	24	6
Depth of hold to spar-deck	31	6
Length of engine and boiler space	108	6
Tonnage, C. H....	2,450 tons.	

Description of engines, oscillating; diameter of cylinders, 65 inches; length of stroke, 10 feet; diameter of water-wheel, 33 feet; length of blades, 10 feet; depth of blades, 1 foot 8 inches; number of blades, 30. Two boilers—one drop-flued, one return-flued; length of boilers, 29 feet 3 inches, and 28 feet 5 inches; breadth of boilers, 14 feet 6 inches; height of boilers, exclusive of steam-chimney, 14 feet 6 inches. Number of furnaces, twelve; length of grate-bars, five feet 6 inches, 6 feet 6 inches, and 7 feet 6 inches. Number of flues, 108; internal diameter of flues, 1 foot 1 inch; length of flues in all, 44 feet. Diameter of smoke-pipes, 5 feet; height of smoke-pipes, 50 feet. Heating surface, fire and flues, 8,000 feet; combustion, natural draught; draught of water at load-line, 17 feet 6 inches; weight of boilers, 224,000 lbs. Floor-timbers at throats, moulded, 16 inches; do. do. sided, 16 inches; distance of frames apart at centres, 32 inches. Frame strapped with diagonal and double-laid iron-straps, $4\frac{1}{2}$ by $\frac{5}{8}$ inches. Masts and rig, brig. Intended service, New York to Havre. Description of coal, bituminous or anthracite.

Remarks.—Engines and boilers enclosed in a water-tight bulkhead.

WIDENING STEAMBOATS.—This novel operation has been lately performed here in two instances. The *Knickerbocker*, originally built for the North River, has been hauled out and widened 2 feet. The *New World*, a boat 375 feet in length, has also been hauled out and widened 12 feet. The manner of operation was as follows:—The planking and the frames were removed from the gunwale to the short floor-heads, and to within about 25 feet of each end; the new frames were then placed and planked, the wheel-guard beams were scarfed out, and the wheels moved out.

New York. H.

CALLEN AND RIPLEY'S "PATENT MULTIPLYING ROTATIVE MOTION," AS A SUBSTITUTE FOR TOOTH-GEAR FOR MULTIPLYING OR DIMINISHING SPEED.

(Continued from p. 137.)

The principle having been so far developed, the practical application becomes one of easy attainment. The Figs. 8, 9, 10, 11, respectively represent the multiples of two to one with two pins and four grooves, of two to one with three pins and six grooves; the multiples of three to one, with three pins and nine grooves, and of three to one with four pins and twelve grooves.

It may here be remarked that any multiple can be obtained by this movement, whether the exponent be an integer or a fraction, provided the said multiple of the number of pins in the smaller disc produce an integral number of grooves in the larger disc; as for example, with the two pins, three grooves would be required for a movement one and a half to one, or four pins would require six grooves; but three pins would require four and a half grooves to fulfil the conditions, which could not be used, as it is not an integral number.

It is obvious that in the attainment of perfect uniformity of motion, uniformity of force follows as a concomitant, since the momentum of a uniform force must be constant: and this conduces to a perfectly smooth and even motion, which in the new movement, combined with the substitution of a rolling for a rubbing action of the parts in contact, results in the following important features :—

First.—That the motion and force applied to the first mover are communicated to and given out by the recipient at the same uniform rate through each increment of space in an entire rotation.

Secondly.—That the friction of the parts in contact are a minimum, and, consequently, the least possible amount of power is absorbed or lost.

Thirdly.—From the absence of back-lash, the action of the movement is quite noiseless.

Fourthly.—The parts being few in number, and of simple form and construction, are easily manufactured, and occupy little space when compared with tooth-gear of equal efficiency.

Fifthly.—The individual parts of the movement are capable of any amount of strength, and, from their simple construction, admit of being readily removed and replaced when necessary.

Sixthly.—The facility afforded for cleaning and lubricating the various parts in contact insures their maximum durability, and which, with their smoothness of action, guarantees a consequent security from accident.

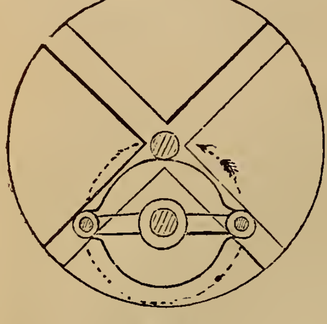


Fig. 8.

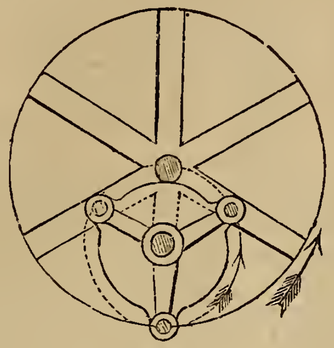


Fig. 9.

The foregoing qualities, so obviously conspicuous in the new movement, eminently fit it for a great variety of purposes where such conditions are essential.

In screw propulsion, where it is a desideratum to produce the greatest practical velocity of the screw-propeller (of low pitch) with the minimum velocity of the engine, and where to attain which the risk and uncertainty attending the use of tooth-gear has been tolerated, and to avoid which the unavoidable introduction of direct-action engines at excessively high speed has been resorted to, and at a considerable loss of fuel and effect, the patent gear will, however, supply the means of obtaining the maximum effect of the power without noise, tremour, risk, or other disadvantage incident to tooth-gear.

In like manner, this movement may be applied with advantage for agricultural as well as all the ordinary kinds of mechanical construction.

With a view to test the capabilities of the invention most completely, the patentees have had a two to one movement constructed, and having had it applied to a steam-engine of about six horses' power, driving the general work and tools of an engineer's workshop, some very interesting facts were developed.

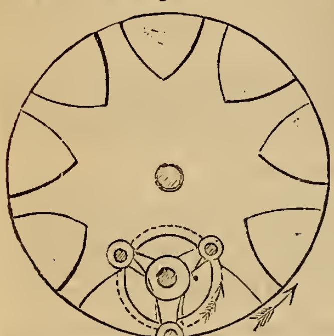


Fig. 10.

Fig. 11.

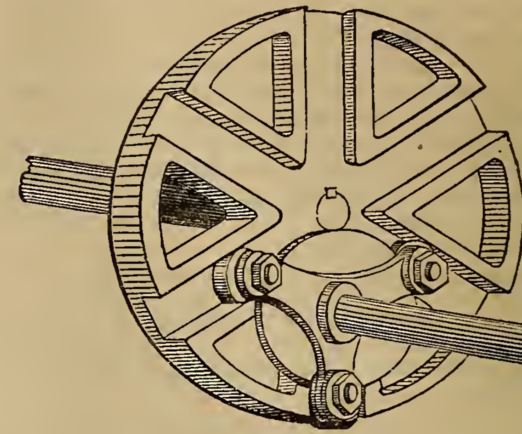
The whole was exposed to the dirt and dust of an open shop, and no particular pains were taken to preserve it from the ordinary casualties attending the use of machinery. After a period of successful working for four months, it has been critically examined, and the result is stated in the accompanying letter. It has also been ascertained on a two to one movement, by direct experiment, that the friction is so small as scarcely to be appreciable.

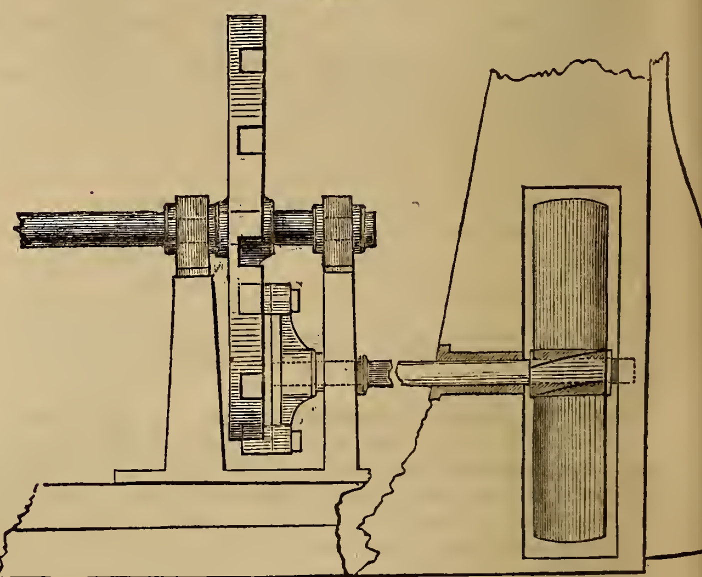
Certificates amply confirm as proved facts the absence of back-lash, the noiseless action, and the durability of the parts of the invention. And it has been the expressed opinions of several practical mechanicians that the movement may be manufactured at about one-half the cost of equally efficient tooth-gear.

It is claimed for this invention that it possesses advantages which are unattainable by any other mode in use, for either increasing or decreasing speed, and which may be summed up in the following recapitulation :—

1. Greater strength and security.
2. Noiseless action.
3. Small space.
4. Simplicity of construction.
5. Reduction of friction, with a consequent greater durability, and more effective application of the power.
6. Less expensive than ordinary gear of equal capabilities.

Possessing these important qualifications, it is not surprising that the invention has received the most unqualified commendations of scientific men, engineers, and naval officers, well qualified to appreciate its merits; to confirm which, an application of it is being made, by the patentees, as a multiple gearing for a screw-propeller, to which purpose the following engravings represent it :—





THE MOTION APPLIED TO A SCREW-PROPELLER.

In conclusion, we freely add our testimony of the advantages which appertain to the application of this invention for the purposes to which we have seen it applied on a small scale, and doubt not that, with carefully-designed patterns, good castings, and accurate fitting, this invention will be found to answer as perfectly for transmitting motion to the heaviest kinds of machinery; and if any corroborative evidence were wanting of the soundness of this invention, and of its practical value for the purposes to which the inventors desire to apply it, we cannot do better than state that Mr. A. H. Renton, C.E., has applied his scientific attainments in the practical working out of the principle.

SUPERANNUATION OF THE CIVIL SERVANTS OF THE CROWN.

We understand that a Bill is about to be brought before the House of Commons by the Government, to regulate the superannuation fund and the payment of pensions to Civil servants.

The gross injustices and favouritisms which were in former times practised, are now but rarely heard of; the jobberies in connexion with patronage, place, and pension, are not as frequent in Admiralty matters as they were but a short time ago: but the injustice complained of in connexion with the Bill proposed to be passed by the Government is evident, and we trust a clause will be introduced to meet the very strong case made out by the professional Officers of the various Dockyards.

They complain, that whilst a clerk may enter the service a boy, and his period of service for superannuation dates from that day, the professional officer may first have to undergo an apprenticeship, next serve as a workman, or in a subordinate capacity, on day-pay, before a vacancy occurs to which he can be promoted; and, however long he may have been in the subordinate capacity and on day-pay, such time does not count as service for superannuation, nor entitle him to the corresponding benefit from that fund. Thus it is that we find the service full of men at the head of practical departments who are past work, and should retire, and make way for younger and more active men; but they are compelled, under the present regulations as to retiring pensions, to drag out a few additional years of servitude, that they may *then* be able to retire upon *a bare subsistence.*

This state of things must not continue—it is an evil that demands immediate attention and remedy, and we trust that the Government will take care that the proposed Bill be so framed as to provide for the matters complained of.

It behoves not only those interested in the question of the date from which service for superannuation shall be reckoned, but also the Members of Parliament who claim to be the reformers of abuses, and who desire to see "the right man in the right place," to be *up and stirring*, for in this matter is involved much more than the mere money question.

The professional Officers in Her Majesty's Dockyards who complain of the unfairness of the present system of superannuation are a very important and valuable class of men; to many of them the nation is indebted for very many practical and valuable improvements, introduced by them, without reward, into the departments of the public service in which they are placed. Their case is a strong one, and demands immediate attention by the Government.

REVIEWS AND NOTICES OF BOOKS.

Dictionary of the English Language as Spoken and Written, with a Grammar prefixed. By Hyde Clarke, D.C.L. Weale.

(SECOND NOTICE.)

Although we have not since our notice of the Grammar prefixed to this Dictionary found opportunity to make the thorough review of these works which we then intended, and still purpose, yet we cannot refrain from a cursory glance at the Dictionary this month. We give such the more readily (and we believe our readers will for the like reason the more willingly receive it), seeing that the work has been—whilst a most laborious and erudite one—a labour of love with its talented author. The fact is, both the author and the publisher have each in their respective parts effected in this instance several entire novelties in an order of work which, upon the first blush, appears but, and is at all events merely called, "a compilation;" and usually such only is "a dictionary." Here, however, the author gives a work redundant with originalities in many of the effective objects for which a dictionary is written. He has introduced and rendered useful to his readers several thousand more words of *real English*, and given them meanings more lucidly, than are contained in other dictionaries; yet is the book less in size than any existing English dictionary—not an *abridgment*. Again, with reference to that frequently-made objection to dictionaries, and that too-often-admitted impediment to the use of books of reference—their weight—why, Mr. Hyde Clarke affords the facility of reference to 100,000 words; 60,000 more than are given in existing dictionaries, in a weight to the hand of only a few ounces; and the publisher has had the enterprise to supply, and is entitled to the merit of affording, in a beautifully clear type, this valuable and important convenience to the reading *many* at the small price of 3s. 6d.; an ingredient appearing to us so wholesome and appropriate, that we with pleasure adopt the unusual course of allusion to the feature of price in a literary notice.

Amongst the author's novelties and decided improvements on his predecessors are the following; and it is to be observed, these are some only of his laudable variations from the beaten track. In addition to all words of general use, words which everybody knows, and which are usually given, we here find thousands of words *not well known*, and not otherwise easily found, yet thoroughly useful and appropriate; amongst them, words which, in the special circumstances of science, art, and technology, are essential to the communication of ideas with aptitude and exactitude.

The lexicographer, too, has taken care that *no word* has been rejected as being *obsolete*. Such words are certainly entitled to introduction in any dictionary purporting to be that of an entire language, though too often omitted; whilst, as Dr. Hyde Clarke truly says, such words may be revived "as the fashions of former ages are reproduced."

Again, there is the novelty, and, at the same time, the very great convenience and appropriateness of arrangement, of the placing the "root-word" at the head of its family of derivatives, even in cases where the exact alphabetical order of the interior letters of the word would have placed the derivative before the "root:" as, for instance—and the first page affords an illustration—

Abbey, *n.* convent, monastery.
Abbatial, *a.* of an abbey.
Abbott, *n.* head of an abbey.
Abbacy, *n.* office of ditto.

Now, in both of these cases the ordinary dictionary arrangement would present the derivative word first, because, in the literal construction of the two words, the letter sequent to the initial of the derivative word is a letter earlier in the alphabet than the first sequent interior letter of the root-word.

Many other points are noticeable favourably in this elaborate and meritorious performance of Dr. Clarke's; but such we shall reserve, hoping to render to him and to our readers more justice, and by means of more space and time, than the pressure of our "class" matter of this month will by any possibility permit.

As some indication, however, of the bold and independent, yet sound spirit which the present Author so usefully brings to a work which in the hands of an ordinary and even able lexicographer is absurd to pass as one of but routine, Dr. Clarke, in an introduction short but serviceable, writes—

"A great merit, *but therein* a great deficiency in our standard dictionaries, so far as their general use by the population is concerned, is, that they are founded on literary considerations, under which a printed authority is required for a word: the word, too, is critically examined before it is admitted; it may be absolutely rejected, or it may lie for years under the interdict of the censors. This is a merit, so far as a written and printed language is concerned, and is strictly applicable to the dead classical languages; but it has seemed to me the English language is to be otherwise treated—indeed, that the English people require something more than a dictionary of book-words. While our literature is to be placed in the highest rank with that of the most celebrated nations, so we have, too, another learning—it may almost be said, another language—to which our political constitution gives no less importance: the words of a Byron, Bulwer, Dickens, Scott, or Cooper, may be read by *hundreds of thousands;* but the words of a Brougham, Webster, Canning, or Clay, sent abroad through the organs of the *Press*, are read by *millions*, and make a no less powerful impression. We may regret that the speeches of Washington, Chatham, or Fox want an appropriate record; but henceforth the reputation of the orator will not depend upon vague rumour, nor his influence be bounded by the Senate Chamber, for, as soon as morning dawns, his thoughts are echoed to a wider audience of his countrymen—the circle spreads beyond the oceans, and he appeals at once to his brethren in England, in America, in Australia, to a nation of freemen, trained to think, to speak, and to act.

"It is the growth of the *Newspaper Press* which has given this importance to the English *oral* language, the influence of which cannot be long neglected. While the lexicographer is hesitating, weighing, suspending, harshly rejecting, or tardily admitting, a language is being worked out, which will react again upon our literature. The periodical press, hardly dignified with the name, much less with the honours of literature, though it embodies some of the most classical compositions in our language, is not accepted as an academic authority; and yet the 'Times' ought to be as eligible an authority as some book long since defunct, and only known by its epitaph, or the title on its coffin-plate. The periodical press forms, nevertheless, the connecting link between the written and the spoken language—between the artificial polish of Macaulay and the rude utterance of the boor; and it exercises a veritable influence, the more especially as some recognized literary forms partake more or less of the *oral* character. Such is immediately the drama, and, to a great degree, as describing actual life, the modern novel of character and dialogue. Apart from philological considerations, the mark of the spoken language, distinguishing it from the written language, is that it lives and breathes instinctive with the inspiration of the moment, receiving new ideas as they are newly born, fresh with the quick growth of an age of rapid progress and teeming invention.

"The new machine or instrument quickly adopted becomes the source of new and ingenious ideas. There is, further, a character of originality appertaining to actual life which impresses itself on our language, and gives to it a vitality and nervousness, as contrasted with academic forms."

This from one we count *of us*—one, too, our profession marked as its own before D.C.L. had graced his name. Let the titled of our profession, or of any other profession, surpass these noble and well-timed sentiments if they can.

It may be thought that we should apologise to our readers for the length to which these notices of Dr. Hyde Clarke's work have already extended, and for deferring the remainder and conclusion until next month, as, on looking through it, we find it much too long to permit its being concluded in the present number; but we feel no apology is necessary: for not alone the artizan and elementary student, but also the scholar and man of high education will find much in the Dictionary and Grammar that is original and valuable, and that will amply repay perusal and study.

LIST OF NEW BOOKS, OR NEW EDITIONS OF BOOKS.

Arithmetic, Exercises in. By R. Rawson. 12mo, cloth, 2s. 6d.
*Chemistry, Foster's First Principles of. 12mo.
Chronometers, Notes on the Management of. By C. F. Shadwell. 8vo, 4s. 6d.
Geology, The Religion of, and its connected Sciences. By E. Hitchcock, D.D. 12mo, sewed, 1s. 6d.; cloth, 2s.

* All preceded by an asterisk are new American works.

Land Surveying, Nesbit's Treatise on Practical. 10th Edit. By T. Baker. 8vo, cloth, 12s.
Mensuration made Easy. By C. Hoare. 12mo, 1s. 6d.
Microscope, Practical Treatise on the. By J. Quekett. 3rd Edition. 8vo, cloth, 21s. Illustrated.
Museum of Science and Art. By Dr. Lardner. Vol. 6, crown 8vo, boards, 1s. 6d.
Musketry, The Theory of. By Major J. C. Kennedy. 2s.

ECONOMIC APPLICATION OF STEAM-POWER.

The county of Devon is growing into some importance in relation to its valuable mineral productions. The copper-mines near Tavistock are about the richest in the kingdom. Other places, along the borders of "the great Dartmoor field of granite," have been discovered, presenting very congenial mineral indications of tin and of copper. Some of these have been opened on, and more or less developed. Success has been found associated with prudence in these matters also. One instance has come to our knowledge which rather invites some record in these pages. The Queen of Dart, copper-mine, which is situate near Ashburton, and on the banks of that romantic and lovely river, the Dart, was opened by a few local shareholders with great caution. They soon came to a very fine vein or lode of copper ore. This ore was raised, and two cargoes have been despatched to Swansea market, where it fetched an excellent price.

Of course, there were not wanting those *friends* who knew that such riches *could not* continue in depth. Hence it was with no small degree of hesitation, we understand, that the uninitiated among the shareholders consented to incur the expense of going deeper than their then five-fathom level. However, an independent shaft was sunk ten fathoms, and from the bottom of it the miners drove across to intersect the contemplated copper lode. This was no sooner done than an abundance of water gushed out, as is usual with good lodes. But the difficulty now was, how to get rid of the water, as it rapidly accumulated, to the impediment of the miners, notwithstanding the best exertions of Captain Billing to raise the water by horse-whim and barrels. Confidence in the mine "proving rich in depth" had not then attained to maturity; at least, not beyond the narrow precincts of those few whom experience had initiated in such matters, and to whom the associated geologic and mineralogic superpositions were so many plain and sufficient indications of associated mineral wealth. Among those who discerned these indications, and reposed confidence in them, was Mr. W. E. Gill, a mining engineer, of Totnes, in that locality, who offered to take a little five-horse engine on wheels, which was then thrashing out corn on a neighbouring farm, and economically accomplish the task of unwatering the mine with it. He has done it, by a clutch taking the arms of the little fly-wheel, and thus driving a pinion, which is geared into a spur-wheel, having bosses on its arms bored to receive a crank-pin, to give any required length of stroke in the pump, by the aid of a connecting-rod and a belt-crank. By this simple arrangement, he at once desirably reduced the original motive speed, whilst he at the same time considerably augmented the available power for pumping, which is highly important.

The engine, which has but 1 foot stroke, was made by Cambridge, of Bristol; and we find that it continues to pump out the incoming water at an expenditure of only 4 cwt. of coals in the twenty-four hours. We ought to add, that this economic arrangement has enabled the miners to develop the lode "in depth," and they have already raised several tons of rich copper ore by this ten-fathom level, and from the five-fathom level, which was previously full of water, also. The present power is amply sufficient, and will be so for some time to come, even though they sink to another level. Such practical experience and business-like economy deserve such success. It is quite possible that such work may have been previously done by similar means, as the plan is so obviously plain and sufficient; yet it were well that it be better known, seeing it so desirably contrasts with the extravagant expenditure, and consequent positive loss of capital elsewhere.

NOTES BY A PRACTICAL CHEMIST.

Citric Acid contaminated with Copper.—Citric acid being now much used in the preparation of lemonade, its purity becomes a matter of some importance. Incidentally copper has been detected in several samples—an impurity not previously suspected. From a bottle of lemonade 26 centigrammes of metallic copper were extracted, being in the proportion of 9 centigrammes to the kilogramme of acid. Samples of citric acid, before being used in the preparation of any beverage or article of food, should be tested with the yellow prussiate of potash, and rejected if a red tint or precipitate appears.

The Gold Deposits of Derbyshire.—Considerable sensation was excited some time ago by the report that gold and silver had been found in the neighbourhood of Haddon Hall. From some paragraphs which are going the round of the provincial press, it appears that these diggings have latterly been inspected by a party of scientific gentlemen from Sheffield, whose report is anything but favourable. The supposed gold-mine occurs in the romantic valley of Lathkildale, near the village of Upper Haddon, and on the left bank of the river Dakin. The valley displays rocks of an exceedingly porous limestone, traversed by bands of an amygdaloid toadstone, slopes of shingle, and *débris* rather promiscuous in character, containing ferrugineous gravels and ochres, clays tinged green with carbonate of copper (a mineral frequently met in Derbyshire, though not as yet in sufficient quantity to be of any practical value), fluor, galena, &c. The toad-stone is often found in large rounded masses, tinged green by chromic oxide, and containing rounded pebbles of quartz, calc-spar, films of red hæmatite, &c. Two excavations have been made in these deposits. The one has brought to light nothing save the above-mentioned minerals. From the other have been obtained large quantities of a soft bluish-grey limestone, containing crystals of a very brilliant iron pyrites. To obtain identified specimens for analysis was not practicable, as the company have expended a portion of their profits (?) in a notice threatening pains and penalties against such a proceeding. Such tests as could be applied on the spot did not strengthen the faith of the explorers in the auriferous character of the specimens before them. They afterwards fell in with an old game-keeper, who professed to be the original discoverer of these diggings, and who exhibited a "nugget" about the size of a small hazel-nut. Judging from its low specific gravity and great hardness, this specimen contains no considerable trace of the precious metal. It is currently rumoured that a few nuggets from Australia have been purposely "planted" in the *detritus* of Lathkildale—a proceeding not unexampled in the history of mining speculation both at home and abroad. Be this as it may, the company are about to procure a crushing-machine in order to grind up and amalgamate the supposed auriferous mass.

ANSWERS TO CORRESPONDENTS.

"Redleigh."—Chromic acid, to become incandescent with alcohol, must be very pure and dry. The presence of water, either in the acid or the alcohol, interferes with the experiment.

"Spectator."—We have frequently adverted to the exorbitant prices of scientific apparatus in England as compared with the Continental scale—a difference quite unwarranted by the comparative outlay for wages and materials. In our opinion, the progress of physical science is seriously retarded by this system of "fancy" prices.

"Veritas."—We detest quacks, and take every opportunity of analysing their pills. Did not the libel laws throw their shield over this system of iniquity, we could "a tale unfold" of very large percentages of mercury found in pills warranted "purely vegetable." But if our correspondent is more anxious to make a fortune than scrupulous as to the means, let him by all means bring out his pill.

"Mercury."—The method of extracting metallic poisons mentioned in our last number has been successfully practised in Paris and New York, but we are not aware of any establishment in London where it has been yet adopted. The extraction of the mercury is proved by its being deposited on the side of the bath. We should not apprehend any danger from the operation, but should advise that the water be made tepid, and the operation not prolonged at once, but rather repeated until all the metallic particles are removed.

INSTITUTION OF CIVIL ENGINEERS.

One of the events in the year, to which we look forward with some pleasure, is the Conversazione of the President of the Institution of Civil Engineers, as it brings together members from distant parts of the country, who are rarely able to attend except on very special occasions.

As usual, Mr. Manby displayed great ability and activity in getting together a large and excellent collection of models, machines, and novelties in art.

Upon the present occasion, Mr. Manby almost excelled his former efforts; for, not only were the novelties in the mechanical arts very numerous and interesting, but a gallery of paintings and sculpture of peculiar interest added to the general effect.

Amongst the most attractive objects displayed were:—Burleigh's Patent Switch, and various other contrivances connected with the permanent way of railways. This subject we have written upon, and some additional remarks will be found in the present number. Mather's Great Earth-boring Machine, which was explained and put in action by Mr. Mather; and a plate illustrating it will be found in our present number, as also a report of the paper read before the Society of Arts. Symons' Electro-magnetic Apparatus for Railway-trains, which we have already described in our pages, attracted considerable attention, and was highly approved of. Berdan's Quartz-crushing Machine; Siemens' Regenerative

Steam-engine; Hanson's Water Meter; How's very simple and ingenious Shears for cutting rods and wire; Macadam's Numbering Machine; Colt's Revolvers; Shepherd's Improved Electric Clock. Norton's very simple Inventions for Registering Numbers, Distance, and Counting were much admired. How's Salinometers; Clifford's Method of Lowering Ships' Boats, which was put in operation and highly approved. Goddard's Patent Duplex Gas Burners were shown in action. Callen and Ripley's very ingenious contrivance of Multiple Gearing was shown, applied to the screw, &c. &c. We must not forget to add, a very excellent Slide Rule for Mechanics, by Mr. Charles Hoare; and the very beautiful and cheap Swiss Drawing Instruments exhibited by Mr. Barlow.

Submarine telegraph matters were well represented by the specimens displayed by Mr. Allen and others, and the plans exhibited for making and laying down continuous lengths of submarine cable, by Mr. William Smith, C.E., the importance of which for the Transatlantic line of telegraph is admitted.

A very interesting work of art, painted by Mr. John Lucas, was suspended in the theatre: the subject is a consultation previously to raising one of the Britannia tubes, in which the artist introduces very striking portraits of Mr. Robert Stephenson and his staff, as also of Mr. Brunel, Mr. Locke and Mr. Rendel, which are admirable likenesses.

The company were hospitably received by the President, Mr. Simpson; the rooms were thronged with all the leading engineers and men of science; and, on the whole, it was a most agreeable reunion.

May 1, 1855.

The discussion was renewed on Mr. Barton's paper "On the Economic Distribution of Material in the Sides, or Vertical Portion, of Wrought-Iron Beams;" and was continued through the evening.

Attention was directed to the recent erection of a suspension-bridge, for carrying railway trains across the river, immediately above the Falls, at Niagara.* The span was stated to be 822 feet 6 inches, and the height of the railway track platform above the river was 250 feet; with a lower platform, for common road vehicles, suspended beneath that for carrying the three tracks for the railways. There were four wire cables, of 10 inches diameter, each containing 3,640 wires No. 9, W.G. The ultimate direct strength was 12,400 tons, and the ultimate supporting strength of the cables was 7,000 tons. The total weight of the superstructure was 750 tons.

The first freight train which passed over was purposely extended to cover the whole length of the platform; it consisted of 20 double cars, each weighing 7 tons, and carrying 10 tons of freight, with an engine weighing 26 tons, making in all 366 tons. The ordinary camber of the platform, when unloaded, was 2·75 feet; which, under a load of 366 tons, was reduced to 1·93 foot. Under the ordinary circumstances of the traffic, 10 cars would constitute a full train. There did not appear to be an undulatory motion, even when the cars attained a good speed, and there was an entire freedom from all vibration. A few heavy teams on the lower platform caused a greater amount of trembling than the passage of a full train on the upper platform.

This bridge had been designed and constructed by Mr. J. A. Röebling, the Engineer-in-Chief, at a cost of about 500,000 dollars. The same engineer, who was also a manufacturer of wire-ropes, had built a suspension aqueduct at Pittsburgh, and was now constructing another suspension-bridge, for carrying the Lexington and Danville Railway across the Kentucky river, by one span of 1,224 feet, at an elevation of 300 feet above the water.

Allusion was made to a paper recently read before the Royal Society by Mr. W. H. Barlow, wherein it was shown, that under the existing theory of beams, in which only two elements of resistance—tension and compression—were recognised, the strength of a beam of cast-iron could not be reconciled with the results of experiments on the direct tensile strength, if the neutral axis was in the centre of the beam. A series of experiments had been made, with the view of determining the position of the neutral axis, and the results showed, that the extensions and compressions proceeded in an arithmetical ratio from the centre to the upper and the lower sides of the beam; and that at any given distance on either side of the centre, the amount of extension was equal to the amount of compression.

The position of the neutral axis being thus ascertained to be in the centre, it was shown, that not only the ultimate strength, but also the amount of extension and compression, with a given strain, indicated the existence of another element of resistance, in addition to the resistances to extension and compression. Further consideration of these results, and investigation of the action of the fibres under different degrees of extension and compression, induced the conviction, that the effect of the lateral action, tending to modify the effect of the unequal and opposite strains in a beam, constituted, in effect, a "resistance to flexure" acting in addition to the resistances of tension and compression.

The questions raised by Mr. Barton's paper were shown to be, the practical value of different modes of constructing the middle rib of any beam, and the mathematical principles upon which its proportions depended.

It was contended that the practical value of each of the methods in common use depended upon the amount of knowledge applied to its details in construction; and as they all possessed important merits, it was necessary for the engineer to decide, for each particular case, which he would use, as unavoidable practical considerations often interfered with the pure application of abstract principles.

In the discussion of the subject, it had been generally assumed, that any change in the mode of constructing the middle rib necessarily involved a change in the mode by which the strains were to be mathematically examined. It was now contended that such a conclusion was erroneous—that no division of beams into classes having different mathematical principles could be admitted, without leading to confusion and error—that one simple principle, or rule, was applicable to every form of beam that had been devised, commencing with the simple square bar, through all modifications of form, up to beams with open trussed sides.

It was contended, that the natural direction of all strains transmitted through the middle rib was one parallel to the top and bottom, and that they would always follow this direction, unless diverted from it by the peculiar construction of the middle rib.

This was illustrated by a square bar, cut through the horizontal plane of its length, in which, when deflected, a movement took place in the relative position of the surfaces in contact, the ends of the upper bar projecting beyond those of the lower.

It was argued, that if these surfaces were again stuck together, so as to prevent this movement from taking place, then the top portion would be brought into compression, and the bottom into tension; and the force, tending to overcome the adhesion of the upper and lower bars, was equal in amount to the tensile and compressive strains at the centre.

Again, if, instead of attaching the surfaces together, a connecting medium were introduced which held them some distance apart, the strength of the beam would be increased in like proportion; but the effect upon the middle rib would remain precisely the same—viz., to resist the tendency of the top and the bottom to move in opposite directions, parallel to each other.

It was then contended, that the simplest mode of ascertaining the amount of strain on the middle rib of any form of beam, was to ascertain that which was acting in compression and in tension at the top and the bottom, and then to consider that exactly the same was transmitted through the rib from the centre to each end, tending to tear through the connexion of it with the top and the bottom; this aggregate amount of strain, as compared with that on the top and the bottom, never varied, but the distribution of it over the length of the rib varied according to the position of the load.

For a beam supported at the ends and loaded between, the formulæ $S = \frac{W L}{4 D}$ and $S = \frac{W L}{8 D}$ gave the horizontal strain, at the centre of the top and the bottom, for a central and a uniform load respectively; where W = total load, L = clear bearing, and D = effective depth; these also gave the horizontal strains upon one-half of the middle rib, which in the former were uniform throughout the length, and in the latter increasing from zero, at the centre, in the ratio of the ordinate of two diverging lines, to the points of support, where they were greatest.

Both these formulæ, applied to the same beam, also included every case of a moving load.

This subject had been fully investigated in a paper by Messrs. Doyne and Blood, laid before the Institution in 1851, when formulæ for all cases were given.

It was contended, that to enter into theoretical discussion on any other directions which the strains might be supposed to follow, was only a waste of time, because, whether the natural direction was the one contended for or not, the accuracy of the conclusions was not affected by it; for when the value of the force conveyed through any particular channel had been ascertained, its effect in that direction must be the same, whether it had been resolved into it from another channel or not. There was, therefore, no objection to assuming that the theory laid down was correct; and its adoption much simplified the consideration of the question. It might, however, be added, in support of this theory, that in a diagonally-trussed beam, such as the "trellis" or the "Warren" girder, wherever the forces conveyed through the trusses met, the resultant was parallel to the top and bottom.

The remarks upon the distribution of the strain through the middle rib, were intended to apply to beams having parallel tops and bottoms; any alteration in this condition produced a proportionate change in the distribution of the forces, though not in their aggregate amount.

The advocates for solid ribs claimed, as an advantage, that the material in the rib added considerably to the strength of the beam; and in practice this was generally true—sometimes to a very important amount. If the rib was always constructed of the exact theoretical proportions, then there would be no additional strength supplied by it; but as various practical considerations often rendered it necessary to make the rib much thicker at the centre than was theoretically required, then, in a solid side, all surplus material assisted the beam, to the extent of nearly 50 per cent. of its value when placed in the top and bottom, which was not the case in beams with open sides.

In ordinary cast-iron beams, where there was, of necessity, a great excess of material in the middle rib beyond the theoretical amount, the additional strength supplied by it was frequently so important, that it could not be omitted from the calculation.

Particular attention was called to this by some experiments, made in 1847, upon large beams, having a clear bearing of 19 feet, a bottom flange of 9 inches by $1\frac{1}{4}$ inch, a middle rib of $19\frac{1}{2}$ inches by $1\frac{1}{4}$ inch, and a top flange of $3\frac{1}{4}$ inches by $1\frac{1}{4}$ inch. These two girders broke with 50 and 54 tons respectively, laid on the centre. The ordinary rule then in use, which did not take the middle rib into the calculation of strength, gave, as the breaking weight of these beams, 26 tons on the centre.

A long investigation, and a great number of experiments, induced the following conclusions:—That when the top flange was not of a less section than one-seventh that of the whole beam, the middle rib affected the strength to the extent of one-half the value of its material as if placed in the bottom flange; —that when a beam was loaded on one side of the bottom flange only, it became necessary to increase the section of the top flange to about one-third the whole section of the beam;—and that when these proportions were attended to, the following rule would be found correct:—

Area of bottom flange
+ Half the area of the middle rib,
× Depth between the centres of the top and bottom flanges,

---

* [The details of this bridge will be found at p. 275 of Vol. x. of "THE ARTIZAN."—Ed.]

× Constant number 28,
÷ Length of bearing (all in inches)
= Breaking weight on the centre, in tons.

This rule gave 54 tons for the beams above mentioned, and it would be found to apply, with equal correctness, to any other proportion of beam, provided the top flange was large enough.

The investigation alluded to extended to the examination of every form of beam, and the construction of simple formulæ for them, and the details were promised to the Institution on a future occasion.

It was submitted, that in the case of the vertical rib of a beam being thick enough not to require strengthening by angle iron, or other bracing, the whole strain was horizontal, and no diagonal strain existed; but when angle-iron pillars were used, and the thickness of the rib was diminished, the normal state was altered, and diagonal strains were induced. The angle irons then had to keep the top and bottom asunder, and performed the functions of columns under compression.

Admitting, then, the existence of diagonal strains, and with the view of throwing the top into compression and the bottom into extension—for which the upright angle-iron columns were not intended—and trying the effect of forces at different angles,—keeping in view, also, the requisite material in the cross section, and the length of each,—the angle of 45° appeared to be most advantageous, both for the ties, and the struts of "Warren" girders, and the intersection of the bars of trellis-beams.

It was due to the designer of the Boyne Bridge to state, that a greater amount of deflection might have been anticipated, from the yielding of the numerous component parts of the trellis-beams, as compared with the more homogeneous construction of plate-beams.

The greatest advantage of the plate-beam over the "Warren" girder and the trellis-beam, consisted in the perfect uniformity with which the strain was brought upon the top and bottom throughout the entire length.

It was contended, that before instituting a comparison between the relative merits of plate or trellis sides for a girder, it was essential to obtain something like a clear notion of the nature of the strains developed in a plate, when placed between two systems of particles constituting the upper and the lower webs of a girder. It was necessary, also, to direct attention to the usual mode of arriving at the position of what was termed the neutral axis of a beam.

The forces supposed to be called into play were invariably assumed to be in horizontal lines; consequently, in a series of lines represented by two triangles, those of the triangle near the upper web of the beam were assumed to be in a state, more or less, of compression, and those of the other triangle, in a state of tension. The point of meeting of the apices of the two triangles was therefore supposed to be neither in a state of extension nor of compression. This portion of the material had, consequently, been generally assumed to be in a quiescent state, and as adding nothing to the strength of the beam. If the forces developed were really horizontal, this conclusion would no doubt be correct; but inasmuch as, whatever might be the deflection of a beam, any one particle of matter in the top could only maintain its relative position, or distance, in reference to any one particle in the bottom, it was obvious that in respect of all others, every intermediate particle must be subject, as the case might be, to extension or compression; and therefore, proceeding from one end of the beam to the other, and tracing the connexion between the top and bottom particles, it inevitably followed, that no one particle could escape being exposed to an infinite variety of strains, comprising every degree of intensity, between extreme compression and extreme tension. Hence it was apparent, that by no possibility could a line of particles be traced in the vertical rib which was not subject to strain, and therefore, although there might be traced a line or lines about which the forces on either side might balance each other, yet, nevertheless, the particles themselves in these lines must be subject to the conflicting strains before adverted to. This view might be illustrated by assuming a neutral axis to exist in any vertical section of a girder; and if the ordinary presumption were true, that the material in the vicinity of the so-called neutral axis was useless, or might be removed without impairing the strength of the beam, it was evident, that by the same reasoning, a line of particles might be removed from the vertical rib, throughout its entire length, without inflicting on it any injury. This was, however, so manifestly inconsistent with fact as not to be tenable. In short, it would appear, therefore, that throughout the whole area of the vertical rib of a plate-beam, every particle was exposed to an infinite variety of strains, both of compression and extension, at angles to each other; or, in other words, every particle was performing a double amount of duty. This view appeared to enable a comparison to be established between the nature of the strains existing respectively in trellis-girders and in plate-beams. In the trellis-girders one system of lines was devoted exclusively to bearing compression, whilst the other system was entirely devoted to resisting extension. If the trellis-lines were, therefore, increased in number, until they formed a continuous plate, it was clear that the vertical rib would be divided into two portions,—one solely resisting compression, and the other extension. Now, since the power of a plate to resist extension could hardly be affected by being exposed, at the same time, to compression at right angles in the line of tension, it would seem reasonable to conclude that a larger amount of material was required when arranged as a trellis than when disposed in the form of a plate. This view might be further illustrated, by referring to a piece of open trellis-work, where it was evident that at each intersection of the bars, double the amount of material was required,—one half of the thickness being under compression, and the other half, at right angles, being under tension. This view was not urged with the object of disparaging the system of trellis structures, but rather as exemplifying the position previously assumed in favour of the system of plate structures.

These views were brought forward, to some extent, without that premeditation required by so intricate a subject, and chiefly with the object of directing the attention of the profession to the question, as it appeared evident that beam-bridges were about to supersede all other systems of construction. It was, therefore, extremely desirable to subject all the systems to the same rigid scrutiny as the trellis and the truss had undergone in the hands of Mr. Doyne, whose valuable paper, presented in conjunction with Professor Blood, in 1851, left little or nothing more to be written on the subject, and the accuracy of the experiments there given had been satisfactorily tested subsequently to the reading of the paper.

Investigations of the principle of the "Warren" girder, with a view to adapting it to positions similar to the Conway and Britannia Bridges, demonstrated the inapplicability of the system beyond a certain span. Such beams did not present greater facilities for transport, or for construction, than plate-girders, and, so far as might be judged from the information laid before the meeting, if the same official rules had been adhered to as had for so long prevented the use of the Torksey Bridge, the Boyne girders would have required considerable strengthening, and the bow and string trussed beam-bridge, which had a deflection of 3 inches, would never have been permitted to be used at all. Still, it was contended, that by employing the proper system for the various situations and spans, and adopting proper proportions for the material, excellent bridges had been and could be constructed, both on the "Warren" and the trellis principles, but better than either by using the plate system.

In reply to the objections urged against the positions assumed in the paper, it was contended that the allegation of the strains in a plate-beam being altogether horizontal, could not be maintained, inasmuch as it was opposed to the simple mathematical proposition, that a vertical weight could not be held in equilibrium by strains which were only horizontal; that it was, therefore, absolutely necessary for a diagonal or oblique strain to exist, in order to effect the resolution of a vertical force into a horizontal direction. If this was conceded, and also that the compressive strains in a plate-beam were carried (as in all plate-beams yet constructed, they were actually carried) by vertical pillars, the oblique resultant must be sought for in the tensile strains passing through the plate-sides, and thus the plate would be doing the diagonal tensile work in the beam; but it had been contended that the plate was taking both horizontal and diagonal strain, and that the plate did perform the double duty which the trellis system could not perform. The simple reply to this was, that the first authorities on plate-beams, and who had given such interesting information on the subject, had never proposed to obtain any definite advantage from the horizontal strains in the sides; that, in fact, they were not in practice calculated on as thus affording strength, and that, therefore, practically they were not of any value, inasmuch as they did not save any material, nor would it be safe to adopt any other practice, with the present amount of knowledge of the actual lines of the strains in plate-beams; and this was confirmed by a closer examination of the subject: for if it was conceived that a portion of plate was acted upon by both diagonal and horizontal strains, it could not be considered as capable of bearing in both directions, as much as it would in one; and that so far as the iron was acting for horizontal strain, so far additional material must be provided for the diagonal strain, whilst at the same time the portion acting horizontally was acting at a disadvantage from not being at the bottom or the top of the beam. This last point was put forward as a probable, but not an absolute determination of the effect of these crossing strains; but it was sufficient to render the advantage of a continuous rib very doubtful, as regarded horizontal strains.

The iron lost at the intersection of the lattices had been looked upon as a matter which increased as the lattices approached each other, and might, if the lattices were very close, cause a loss of about 50 per cent.; but it was submitted that the Author of the paper did not contemplate greater loss in this way than in the Boyne Viaduct, in which the amount really lost in the sides from that cause was rather under 1 per cent.

It had been said that the angle of economy for bracing was not determinate, and where plate-beams were concerned, this was admitted to be indeterminate so far as the present knowledge extended; and in this consisted one great advantage of the trellis-beam, inasmuch as both the angle of economic bracing, as well as the amount of strain in the trellis, could be investigated with mathematical correctness. The statements in the paper, respecting a saving of 33 per cent. in the sides, were not in any way modified or withdrawn, and the angle of 45°, which was assumed for the investigation of the plate-beam, had been so assumed because it was the angle which gave the plate-beam most advantage, and it was contended that the saving in practice was over that percentage.

It was contended that the tubular beams now being constructed for the "Victoria" Bridge, over the St. Lawrence, which had been adduced as examples of excellent proportions of material, might be used for demonstrating the saving which would have been effected by the adoption of trellis sides. This portion of the subject would be reserved for treating at the resumed discussion.

The paper had been listened to with great patience—the views it propounded had been received with much kindness, and it had, at least, the merit of having induced some of those who justly stood at the head of the profession to come forward and give to the Institution their thoughts and views on an important subject, in a very instructive manner.

ON PUBLIC WORKS FOR INDIA, ESPECIALLY WITH REFERENCE TO IRRIGATION AND COMMUNICATIONS.*

By Col. Arthur Cotton, late Chief Engineer, Madras.

(Continued from page 142.)

When I speak of nothing whatever being done towards a systematic arrangement for supplying India with communications, I do not mean to say that people do not fancy that they are doing this. They continually talk as if what was now doing about railways was really the supplying India with a system of communications; but there could not be a more palpable delusion. Suppose England were surrounded by land instead of water, so that it had no coast

* Paper read before the Royal Society of Arts, April 25, 1855.

communication, that it had no turnpike roads or canals, and that all that was doing was to make half a mile of high-speed railway a year on each of three lines, such as from Southampton to London, from Liverpool to Birmingham, and from Edinburgh to Glasgow, so that in 100 years three or four main lines of such railway would be open, while all the rest of the country was waiting for these works; and when the founders of this scheme were remonstrated with, they reply, "Wait a little; we are making a grand experiment; we are trying whether we cannot have perfect communications at once." So they begin in spending five years in laying 150 miles of railway, during which time the country has lost at least 150 millions sterling for want of communications—for this want causes a loss of at least thirty millions a year to India—much more than the whole of the taxes. This is rather an expensive experiment.

I will now proceed to consider the state of the country in respect to its irrigation. This, in fact, corresponds exactly with that of the communications. One single district, Tanjore, has been in a certain sense systematically attended to, almost from our first obtaining possession of it. About 30 years ago, one or two of the old Mahommedan canals in the North-west were restored and improved, and within the last eight years two extensive systems of works—one on the Ganges, and one on the Godavery, already mentioned as communications—have been undertaken, and are both now partially in operation. But, with these exceptions, there is scarcely a district in India in which even the old native works have been fully kept in repair; indeed, there is not one in which multitudes of works (where they exist) are not in every stage of insufficiency down to complete ruin, though in some districts many of the most important have been both kept in repair and improved. Of the consequences of this, in the awful famines that have repeatedly desolated the country, we have had abundance of lessons which *à priori* one would have thought it was impossible that men could help learning from. In one district of Guntoor, in 1833, 200,000 out of half a million inhabitants perished. On this occasion nothing could induce the Government to move a finger till 70,000 of those starving men, having left their families to perish, invaded the city of Madras, when it was found that *something could* be done; but it was then too late. But I am not speaking only of 20 years ago; only last year there was a severe drought, which gave a certainty of scarcity, and probably famine. The matter was pressed upon the Government, especially with reference to the district of Bellary, where the scarcity was greatest. But nothing could induce the Government to take any really effective steps to provide for the time when the means of the people would be exhausted. The consequence was that 100,000 people had to be fed at the Government expense, without any proper preparation or organisation, and almost the whole of the money so expended was in consequence thrown away. Had preparations been made, 100,000 men in six months might have executed a system of irrigation works which would have secured the district for ever from actual famine, unless under such circumstances as have never hitherto occurred. There are only two districts at this moment in the whole Mandras presidency, excepting those I have mentioned, where, if there were such a failure of the monsoon as has often before occurred, there would not be all the horrors of famine; and this is generally the case throughout India. The way in which the actual state of things has been hidden from the people of this country has been by mentioning two or three works that have been undertaken within the last few years as representing the general system of management, which is nothing more nor less than a complete deception.

I must, however, give some account of what has been done. In Tanjore, on an average about £8,000 a year has been laid out for forty years on public works; and this trifling sum has been sufficient, not only to keep the old works in repair, but to pervade the whole district—in a rude way, indeed—with an effective system of irrigation and common roads with bridges; and the results have been that the population has increased from 800,000 to 1,500,000, and the revenue from £320,000 to £500,000, while the other districts have remained nearly stationary. This district has never had even a scarcity; and on every occasion, without exception, of famine in other parts of the country, it has poured out enormous supplies of food. While almost the whole of the lands of the presidency are worthless, that is, unsaleable, the whole of the Tanjore lands are saleable at prices about equal to those of England, allowing for the difference in the value of money. The works of the Godavery were commenced eight years ago, and a large portion of the 1,200,000 acres to be ultimately benefited are now receiving water, though in an imperfect way. The result already is, that last year, one of severe drought, when all the surrounding country suffered greatly, so that grain was double the ordinary price, the revenue of the district was 25 per cent. higher than the average of years before the works, a difference of £50,000, and the sea exports of produce alone were £170,000 against £30,000, the average of years preceding the works, and this besides the vast exports to the surrounding districts by land.* The cost of these works has been about £200,000, and probably about £300,000 in all will be expended.

A similar set of works is now commenced on the next river, the Kistnah, and they are also partially in operation.

But the greatest work is the grand canal led from the Ganges, from the point where it enters the alluvial country before alluded to. It will cost about two millions, equal to twelve millions in this country, so that it is the largest engineering work in the world. It was begun about eight years ago, and some water has already been admitted, but it is only in operation to a very small extent yet. It is, however, a noble and most important work, not as a work of irrigation only, but as a line of steam-boat communication, if it is perfected. As such it will be, excepting the Erie and the St. Lawrence canals, the most valuable communication in the world; and if it were carried on to Calcutta, it would be the most important without exception.

The state of the coast in respect of harbours is just the same as the interior in respect of communication and irrigation. Madras is at this moment in precisely the state it was when we first occupied it; there is neither a breakwater for the shipping, nor any means for communicating from them to the shore, except by the catamarans and masoolah, or surf-boats, that we found there. Not £20,000 has been spent in all the ports in the Madras presidency. At Coringa, on the east coast, there is a safe anchorage; but, for want of a dredged channel of 3 or 4 feet deep through a bank, ships cannot get into the river for repairs if they draw more that nine feet. In almost all the ports a master-attendant is paid, perhaps, £100 or £150 a year; and as it is seldom that an efficient man can be found at such a price. I have known one so employed who was not a seaman, and who was utterly without one qualification for the duties. Such is the astonishing misapprehension of the value of ports to the country.

It must not be supposed that there was not nominally a system of management for public works, but that the department was ludicrously inadequate. In a tract of country requiring twenty Europeans, and an expenditure of £50,000 a year, there would be one European, and an expenditure of £1,000 a year. In the district of Rajahmundry, the expenditure had been, up to 1840, £400 or £500 a year, for all the roads, tanks, canals, rivers, &c., and a fifth share of the time of one engineer, in a district containing 7,000 or 8,000 square miles, one-seventh the size of England. Now, surely nothing can be more obvious than this, that on taking possession of a tract of country, the very first thing should be to form a department and sanction an expenditure adequate to the following works:—

1st. To keep in repair all existing public works, such as tanks, canals, &c.

2nd. To provide it with some kind of rough communication with bridges.

3rd. To apply our Western science in improving the rude works of the natives.

4th. To extend the means of irrigation till the district was in some degree secure from famine.

5th. To provide some kind of communication superior to common roads in at least a few main lines.

Without this it is absolutely impossible that the country can increase in wealth and provide the means of instruction, &c., or even for justice, &c. While the whole population of a country is employed in raising food, nothing can be done towards elevating them. England is rich, and can afford to acquire knowledge, because by means of public works so much is done that must otherwise be done by human labour; the necessaries of life can be provided by the labour of only a small portion of the community, and there is consequently a vast amount of human labour available for other things. India is poor, because, excepting bullocks, it has nothing that saves human labour; and this lies at the root of all its evils. Its courts of justice are 100 or 200 miles apart, because, with the present revenue, the Government "can't afford" to have more. The whole people are in a state of the greatest ignorance, because the Government "can't afford" to educate them. It is impossible for any person who has not been for some time resident in India, to conceive the indignation one feels at the sight of these masses of people so utterly neglected. To have some adequate apprehension of this, one had need to have laboured for thirty years among these millions, wholly without the knowledge of anything worth knowing, and generally in the lowest state of poverty, because not provided with those public works which are essential to improvement of any kind, while we had it in our power to bestow upon them a share of all those advantages which we possess in England. Of the way in which the subject of communications has been valued, not fifty years ago, but quite lately, two anecdotes will enable one to judge. A demand was made for £1,000 to provide for an expedition being sent up from the Delta to examine the Upper Godavery; papers by the Civil Engineer, Revenue Commissioner, the Board of Revenue, and others, giving at length information on the subject, showing that it was the natural communication between the coast and ten millions of people; that it opened up the best cotton tract out of America; that 30,000 tons of cotton a year were now sent from it 400 miles on bullocks' backs; that it could supply cotton enough for England two or three times over, &c. This was sent to the Government of India; and so utterly insignificant did it appear to them, that they did not think it worth while to answer a single paragraph of any of the papers, but merely replied, in three lines, that they doubted whether it would be useful, and that, in the present state of the finances, the money could not be granted. At the time that this £1,000 could not be spared to examine a river by which England could be supplied with cotton, there was, according to a letter from the India House to the Government of India, £13,500,000 sterling, in rupees, in the treasury.

The other case is this:—An engineer sent in an estimate of £700 for cutting a few miles of canal to connect two long lines of backwater on the west coast of the peninsula, on which there was already a great trade. In refusing this, the Madras Government directed the engineer in future to attend to matters of more importance, and not to occupy himself with such things.

Again: In a paper by the Government consulting engineer, Col. Baker, written by order of the Governor-General on the subject of public works, he sums up his views on the subject in a series of conclusions, in which not a word is said on the importance of giving India generally a system of communication without delay; not a word on the effect of cheap transit, nor a word on the importance of irrigation.

These things show the astonishing misapprehension of the whole subject that still exists on the part of old Indians, and the absolute necessity of bringing the matter under the notice of the people of England, who, not having breathed the atmosphere of indifference to Indian improvement by means of public works for thirty or forty years, are capable of receiving right impressions on the subject.

What I insist upon is this:—

1st. At this moment the great mass of India is without those public works which are essential to the welfare of the people. The works which have been carrying on of late years, in a few localities, viz., the Punjaub, Agra, Rajahmundry, and Tanjore, if brought forward, as they constantly are, as representing

* One year the exports of *produce* (exclusive of small cloth trade) of this, nearly the richest alluvial tract in the world, had actually fallen to £9,000, a tract capable of bearing 2½ millions of people.

the general state of India, convey a totally false impression of the actual state of things. They are merely exceptions; and,

2nd. That after all the pressure of English public opinion that has been brought to bear upon this subject, there is as yet no symptom of the formation of a department of public works at all adequate to the wants of the country. As to the great railways as at present carrying on meeting the demands of the country, no greater delusion ever existed. Suppose Yorkshire was without one mile of canal or common road, and the inhabitants were told that Government were laying a first-rate railway from Southampton to London, which, in course of time, might be extended northward, so as at last to pass through that country: such is a correct representation of the case as respects the great mass of India.

Even were it possible to lay 100 miles of these railways where they now lay one, they would not answer the purpose. What would be the state of Yorkshire, even when the railway did reach it? Would a single railway running through it supply the place of its 10,000 miles of canal, light railways, and turnpike roads? It is not one communication passing through a country that opens that country. The whole country must be pervaded by communications. Again, they propose to charge on these railways a penny a ton a mile, corresponding with sixpence in this country. In the first place, the Ganges, in its present unimproved state, carries at one-third of a penny a ton a mile; and were it improved, as it might be—were a hundredth part of the money required for a mile of these railways laid out on each mile of the river—it could be worked at one-sixth of a penny. But even where a railway has not to contend with water carriage, as in the case of the valley of the Ganges, what effect will it have upon the distant traffic of the country, carrying at a penny a ton a mile? This on 500 miles would amount to £2 a ton. It is evident, from all that has been written upon these Indian railways, that nobody concerned in them is aware that the railways scarcely touch the distant traffic even in England and America. At a late meeting of the English North-Western Railway proprietors, it was stated that the average receipts were—

	s.	d.
Per ton of coals	2	3½
Do. „ goods	7	2
Per passengers	2	8¼

I do not know exactly what the charges for coals are, but if we allow only a penny, which is certainly below the mark, they are thus only carried, on an average, 27½ miles. The charges on goods are from 1⅝d. to 9d.; if we take the average so low as 3d., the distance they are carried is only 29 miles; and the passengers at an average of 1⅝d. a head, the average distance is under 20 miles. In *Herapath's Journal*, again, it is stated, that the total receipts in all England for 42 million passengers is only 3½ millions sterling, which gives 1s. 8d. only per passenger; and allowing 1⅝d. as the average per mile, it gives an average distance travelled of only 12 miles, showing, at the prices charged on English passengers, how extremely small the amount of travelling is even in this wealthy country on long distances. Again, Lardner gives the average distance that goods are conveyed in America by the railways at only 38 miles, and adds—"*But little merchandise is transported by them, the cost of transit by them being greater than goods in general are capable of bearing.*" He also shows that in Belgium only 12 out of 1,000 tons are carried more than 100 miles. Again: In all that has been written about these Indian railways, the great fundamental principle of traffic is never once referred to, viz., that its amount on any given line is proportioned to the cost of transit. On the main line of all—that up the valley of the Ganges—it is proposed to convey goods at three times the cost by the river in its unimproved state. But even on other lines it is merely proposed somewhat to reduce the present cost, as from 1½d. or 2½d. to 1d. But the real question is not, Will the railway carry it at a rate somewhat lower than the present rates? but, Will they carry at the lowest rates that are attainable? If goods are carried at 3d. a ton, there will be, we will suppose, a traffic of 50,000 tons a year; if, on the same line, the rate is reduced to a penny, perhaps 100,000 tons will be carried; if to one-eighth of a penny, perhaps half a million; and if to one-sixteenth, probably a million.

The value and quantity of goods conveyed on any line in India, supposing a million conveyed, may be something like this:—

10,000 tons of £50 a ton and upwards;
100,000 tons of £10 and upwards, such as cotton, sugar, saltpetre, iron, &c.;
300,000 tons of £3 and upwards, such as rice, salt, &c.;
600,000 tons of inferior grains, firewood, straw, building materials, &c.

Nineteen-twentieths of these things would not bear transit for any distance at 1d. a ton a mile; yet upon every ton moved there would be some profit, or they would not be transported at all. It is stated that in the Ganges the traffic is two million tons a year. Were the country deprived of this river navigation, and left dependent on the railway, at least nine-tenths of this traffic would be destroyed, Calcutta reduced to a fourth-rate port, and all Bengal and the Upper Provinces paralysed; just as would be the case now with Manchester. The railway could not possibly carry a quarter of the present traffic; and if the water communications were destroyed, Manchester would be like a sailing-ship becalmed.

Thus, nothing is really doing towards the two grand objects, irrigation and the effectual opening up of India. Even from want of the latter alone, though the actual loss is really immeasurable, yet it can easily be shown that the annual loss for want of cheap communication is certainly more than the whole amount of taxes, that is, 25 millions; and, consequently, that at least this sum is thrown away every year that this work is delayed.

What is required is that arrangements should be made for "at once" irrigating and opening up every district in India. There is no shadow of a reason why what is now doing in Rajahmundry should not be at the same time carried on in every other district. The money is procurable, and the European superintendence necessary is also procurable to any extent; and if £50,000 were expended annually in every district, or about five millions a year, within ten years the whole face of India would be changed.

But the money must, of course, be expended with some sort of judgment. Suppose, instead of watering and draining 1,200,000 acres in Rajahmundry, and supplying it with 1,000 miles of water-transit at a farthing or less per ton per mile, at a cost of £300,000, the district had been left in its former neglected state, and one line of 30 miles of fine railway made in one corner of it instead, would the advantages of this expenditure have been one-hundredth part of those derived from the present works? Would it have raised the revenue by £50,000 a year, and the exports from £30,000 to £170,000 in a few years, and before half the works are in operation? Would the district in the last year—a year of extreme drought—have been selling the largest crop ever produced at famine prices, instead of buying at those, or rather at much higher prices?

All the districts certainly could not be improved in exactly the same way as Rajahmundry, because it is a delta, and has peculiar advantages both for irrigation and water communication; but they ought all to be improved on the same principle; that is, every advantage should be taken of the peculiar natural facilities of each district, to supply it as quickly as possible with these two grand requisites—irrigation and cheap transit. Is not this a palpable principle? But, as a further illustration of the strangely blind way in which the improvement of India has been set about, let us again refer to the case of the Godavery. Here is a river which has already been navigated (for as many months in the year as the Erie Canal is navigable, upon 360 miles of which £6,000,000 sterling has been spent), leading from Berar to a safe port. The work which has been recommended, and upon which already, I believe, £500,000 has been spent, with the proposed object of getting at the Berar cotton, is a railway to ascend 2,500 feet, and then descend 2,000 feet; to be 400 miles in length; to cost about £3,000,000 to £4,000,000; to take from ten to twenty years to construct; and, when finished, to convey the cotton at probably 1d. a ton a mile (the projector estimated the cost of transit at 2½d.); while the river is now available to carry it at one-eighth or one-fourth of a penny a ton a mile, and which may probably be made an excellent communication throughout the year for a tenth or twentieth of what the railway will cost, and convey the cotton at a tenth part of the cost of transit by rail.

Ultimately, the basis of a system of communication for India must be water communication. Nothing else can meet the wants of India. This is fully proved in America. All the heavy and distant traffic is carried by water. The Hudson, the Mississippi, the Erie Canal, the St. Lawrence navigation, &c., are the only lines that carry a great traffic in long distances. The Erie Canal was first cut as a mere ditch, 360 miles, from the Lakes to the Hudson, for £1,500,000 sterling. In 1840, ten years after railways were in operation, it was enlarged at a cost of £4,500,000—three times its first cost,—but still worked with animal power. It has been determined greatly to enlarge it for steam-power, that it may contend with the St. Lawrence steam-canals; and yet these canals are shut up from five to six months in every year by frost.

Hence, whatever the feeders are, the main communications in India must ultimately be canals or rivers.

But the immediate question is not so much, What is the cheapest mode of transit? as, What are the means by which the main weight of this tremendous incubus, which completely paralyses the energies of India, may be most speedily removed? There can, I think, be but one answer to this. Over by far the greater part of India nothing can be done so quickly as to lay down light railways to be worked at low speed: these can be laid down by thousands of miles in all the populous parts of India without the least difficulty. Wherever river or canal communications on main lines can be speedily obtained, they should of course be established, and the light rails laid as feeders to them.

In the course of the experience I have had in public works, I have had to lay several miles of light railway in India, which have been worked for years; and in this way I have had good opportunities of learning what was really wanted in a low-speed railway, such as would at the least expense and in the shortest time provide the means of getting rid of the greater part of the cost of transit. But nothing I had tried or thought of satisfied me till I saw Mr. Crosskill's specimen of his railways at Beverley, in Yorkshire. The roads that he had formed exactly met my idea; and I would send out many thousand miles of such roads to India every year. Mr. Crosskill proposes three different kinds of rails for heavier or lighter waggons; and one of these three, I think, would be admirably suited to the different sorts of lines that would occur in India. In some parts of India, near the forests, I would saw up timber on the spot, and only send the iron from England; but for a great extent of country I would send the rails complete with timber, ready to be laid down; and I would have the least possible amount of labour expended on the ground, so as to get the rail into operation as soon as possible.

I should mention that some consideration is beginning to be given to this question of rapidly opening India. A line of light rails has been ordered to be laid from Negapatum, 180 miles south of Madras, to Trichinopoly, due west 90 miles. A line has also been ordered in Bengal, and the Governor-General has lately called upon Col. Baker, the consulting engineer in Bengal, for a report upon the papers I have written upon this subject. In Col. Baker's paper, as I have mentioned, he scarcely touches upon the main points of the subject, viz., the effects of very cheap transit, and the enormous loss the country is sustaining every year that it is delayed, &c.; but he says, "The consideration of this question has left me deeply impressed with the importance of the subject; and though I dissent from many of the views expressed by Col. Cotton, and though I dispute many of his calculations, I cannot but feel that he argues from sound principles, and that his plans for the improvement of communications at small cost in some localities by means of canals and rivers, and in others by an inferior class of railway, are eminently deserving of attention." He also calculates that light railways can be laid at one-fourth of the cost and in one-fourth of the time that high-speed railways can be constructed; so that he grants that at the end of 10 years, for instance, one might have either 1,000 miles of high-speed railway or 4,000 of low-speed; at the end of 20, suppose either 5,000 of high-speed or 20,000 of low-speed, and so on. If the question was this alone, surely there could be no doubt which should be preferred in a country requiring at least 100,000 miles of main lines, and 400,000 of secondary ones. Col. Baker's paper is the paper of a very candid, intelligent man—obliged suddenly to write on a subject of vast extent and importance wholly new to him, so that he had not even time to discover the main points in the question, and at the same time feeling himself on very delicate ground, as the views he was called upon to examine were diametrically opposed to the principles upon which public works are now being carried on in India.

The gentleman who has revenue charge of the district adjoining Rajahmundry, and one side of which consequently receives water from the Godavery works, has lately written a report, endeavouring to impress upon Government the great effects of money expended, as it has been there, upon irrigation and canals; and it seems well to make here some quotations from him, to show what is the state of the greater part of the country, and what it may be made and ought to have been many years ago:—

"I have above alluded to the wretched state of the Culdindy Pergunnah (small division of a district), which contains a very large quantity of valuable land, the greater portion of which has long been waste, chiefly from want of the means of irrigation. The average revenue has been £340 per annum. This year an irrigation channel was *commenced;* immediately tenders for the Pergunnah came in; and it has been given on three years' lease, for £700 the first year, £750 the second, and £810 the third;" so that the moment the channel is begun, the revenue is increased two-fold, and within three years 2½-fold. He goes on to say—"but no estimates of the quantity of food which has been produced through improved irrigation, no actual return of increase of revenue realised in an irrigated district in a year when such heavy remissions of taxes have been found necessary in other less favoured tracts, can convey any idea of the benefit which has accrued both to the Government and the people, at all to be compared with that derived from actual observation of the effects in travelling through the district. No one could have witnessed, as I did, the wretched condition of the people, and the crops on the Kistnah side of the district, the difficulty of obtaining even the scantiest supply of only moderately impure water, and then have passed to the Godavery side and witnessed with delight the contrast, the abundance of pure water, the splendid crops, and the comfort of the people, without being deeply sensible that no figures can at all convey a true idea of the priceless blessing which the waters of the Godavery, brought by means of the weir and channels through such an extent of delta, have conferred upon the people. In May I was encamped at Avenguddah, on the banks of a large branch of the Kistnah, then a sheet of sand. The cattle were dying by numbers from starvation; no signs of vegetation were apparent; the water was wretched; and I hope I may never again see so much poverty and wretchedness. The month of June was passed by me at Akeed, more than thirty miles from the nearest point of the Godavery; but there fresh water and forage were abundant. The water of the Godavery, which had passed through the head sluice fifty miles up the channel, flowed past my tents; and numerous boats, laden with the produce of the neighbouring lands, daily passed to and fro. Grain was far lower in price than in any other parts of the districts, and I do not doubt that the cost of transit has been reduced to one-third of what it was before. I have already advocated the extension of a canal in continuation of that which passes Akeed to the port of Masulipatam. The same grain which sells at £5 5s. per ton in Akeed, brings £6 15s. in Masulipatam. If the canal were continued, 5s. a ton ought to be about the difference, instead of £1 10s."

He goes on to show that there has been an increase of revenue of 42 per cent. on the Godavery side of the district. But may it not well be asked, why is this the state of things on one side of the district after we have possessed the country fifty years? Is it only now discovered that public works make the difference between the most abject poverty and wretchedness, and abundance and comfort?

It is impossible to touch upon the hundredth part of the points of importance on this subject in so short a paper as this, and the view of it taken here must necessarily be most imperfect. I have endeavoured to select the most essential points; and the following propositions will show, in a small compass, the views which I hold:—

1st. That the greatest possible mistake has been made in our management of India, in neglecting to execute those works of irrigation and communication which lie at the foundation of the improvement of the people, not only material, but also moral.

2nd. That nothing can be more obvious than that in every district, the moment it was taken possession of, a sufficient establishment and expenditure should have been allowed—1st. To keep in repair the old native works; 2nd. To construct new and far more perfect ones, worthy of our superior means and knowledge.

3rd. That the improvements that have of late years commenced in a few districts do not at all represent the general state of things throughout India; but that at this moment the great mass of India is utterly unimproved, and unprovided with those works which are essential to all improvement.

4th. That the construction of a few hundred miles of high-speed railway will not in the least meet the wants of India; that every district ought at once to be supplied with works of irrigation, and pervaded with an extensive system of communication of cheap transit.

5th. That to spend £10,000 on a single mile of communication, when the same time and money could be expended in other ways so as to produce from 10 to 100 times as much useful effect, is the greatest mistake.

6th. That nothing but canal or river communication can provide India with sufficiently cheap transit for its long distances and the small value of its main articles of transport.

7th. That the grand point of all, as respects communication, is to get any rough works executed to a vast extent over the whole face of the country in the least possible time, so as to relieve it from the tremendous incubus which at present effectually represses all its energies.

8th. That a department ought immediately to be formed adequate to the vast work which has to be accomplished.

9th. That every facility should be given to really free private enterprise. The railway companies at present existing are no more really private companies than the Indian Civil Service.

10th. That while the *value* of water for irrigation is at least £1 for 6,000 cubic yards, it can be provided on a large scale at a cost of £1 for 300,000 cubic yards, or 1-50th part of its value.

11th. That probably steam-boat canals can be worked at one-eighth of the cost of working high-speed railways, and improved rivers also at one-sixth or one-eighth of the latter.

God has been pleased to set before us the duty, not to say the unspeakable honour and privilege, of incalculably promoting the welfare of 150 millions of people—one-seventh of the population of the whole globe; and as, according to the laws of His kingdom, it is impossible to do good to our neighbours without benefiting ourselves, there has been, at the same time, necessarily placed before us the opportunity of immensely increasing the glory and power of the empire, by raising five-sixths of its population from a state of abject poverty, ignorance, and despondency, to that of a thriving, wealthy, educated, and Christianised people. But hitherto, though we have indeed given them internal peace, we have entirely failed to be the instrument of conveying those blessings to them that, as a Christian and civilised nation, we ought to have done. But I do feel confident that, in God's good providence, the time is at hand when we shall arouse from our torpor and introduce a new order of things into India—an order of things which will effectually prevent the natives pointing to the ruined tanks and weirs, and remarking upon the superior abilities and benevolence of their own great rulers to us, when in so many instances we have not even kept their noble works in repair.

Here lies before us now in India an unbounded field for the utmost display of the energies, the science, and the benevolence of England, and an equally unbounded field for the employment of her capital and the improvement of the supply of all those raw materials which are required for the still-increasing development of her manufacturing power. And it must be remembered that in proportion as the natives of India become sellers of their own produce, they must necessarily become purchasers of our manufactures; and thus, also, will our care for our fellow-subjects necessarily return in extensive benefits to ourselves.

To give some idea of the comparative cost of transit by different modes, I add a statement of the actual rates on various lines of communication:—

	Land miles.			
OCEAN TRANSIT.				
London to Calcutta, 15,000—outward		£1 10s., or	1/40d.	a ton per mile
Do. do. homeward		3 0	1/20	"
COASTING.				
In India	200 to 500 miles		3/8	"
Colliers in England	350 "	9s.	1/3	"
Steam do., as stated at late C.E.'s meeting		4s.	1/7	"
RIVERS.				
Ganges (by men)	500 to 1,000 miles		1/4 to 1/3	"
Do.	100 "		3/4	"
Mississippi (steam)	up to 2,500 "		1/6	"
Hudson do.	160 "		1/7	"
Indus do.	500 "		1½	"
Do. do.	"	down do.	1/2	"
Ganges do.	"	up stream	3	"
Do. do.	"	down do.	3/4	"
Weaver Navigation, in England (animal power)	24 "		1/2	"
CANALS.				
Rajahmundry Canals, men, 20 to 80, no tolls			1/6 to 1/3	"
Madras Canal, men, 40, including toll			1/4	"
Erie Canal, animal power, 360, including heavy tolls			7/8	"
St. Lawrence Canal, steam, 700, including tolls			1/3	"
English Canals, animals, without tolls			1/3	"
Do. do. with tolls				
RAILWAYS.				
In England, steam, 10 to 200, with tolls			1¾ to 9d.	"
Do. mineral lines with low speed, 10 to 30, with tolls			1	"
In America, steam, moderate speed			1¾	"
German States, steam			2 to 7	"
France, steam			1½	"
East Indian, steam, proposed			1 to 2	"
Belgium			1¾	"
English Railways, actual cost of working (1847), according to Lardner			1 1/9	"
COMMON ROADS.				
In India, bullocks			1½ to 4	"
Passengers by English railways			1 to 3	"
Do. on the Hudson, at 20 miles an hour			1/6	"
Do. by sea, from London to Edinburgh			1/3	"
Do. on the Rajahmundry Canals, in boats worked by men			1/8	"

It thus appears that by far the cheapest transit is that by the ocean on long distances, and is from one-twentieth to one-fortieth of a penny per ton per mile; that the next is by inland steam-navigation, being about one-sixth of a penny when there are no tolls; and in the St. Lawrence canals, one-third of a penny with tolls: that in the Indian rivers it is from one-third to three-fourths of a penny, worked by men; on Indian canals, from one-sixth to one-fourth of a penny, also worked by men, and for very short distances. On long distances this would, of course, be reduced to perhaps one-half, or from one-twelfth to one-eighth; and on canals suited for steam-boats of considerable tonnage, certainly less than these rates, or probably one-sixteenth of a penny. By coasters, on distances of from 300 to 500 miles, about one-third of a penny both in India and in England; and it is stated that by steam-coasters the actual expense would not be more than one-seventh in the latter. By canals, worked by horses in England, the actual cost is stated by a canal manager to be one-third of a penny, exclusive of toll. On the Erie Canal, open only six months in the year, and yielding very large profits, worked by animal power, seven-eighths of a penny, including tolls.

By railway, as far as I can ascertain, the actual cost of transit, including a fair share of all expenses, where the railway is worked by quick passenger-trains, as in England, is at least one penny. On a mineral line, worked at six miles an hour, I was informed that it was rather under a penny; the cost of trucks alone, at that low speed, was stated to be from one-eighth to one-fourth of a penny. If the coasting trade can be carried on at one-third of a penny by sails, and at one-seventh of a penny by steam, certainly a steam-boat canal for vessels of 300 tons burthen, like the Canada canals, could, in England, be worked at one-tenth of a penny a ton, exclusive of tolls, for distances of 100 miles and upwards; and in India they could probably be worked at one-sixteenth of a penny for long distances. They reckon upon charging on the railway in India at least a penny, which is probably eight times what would be charged on steam-boat canals, including tolls, and six or eight times as much as improved river navigation would cost there.

The Indian mail just arrived contains a remarkable case in confirmation of what I have said of the strange misapprehension of the subject of communication:—

"The Indigo Planters' Association have just remonstrated with the Government upon an extraordinary case of this kind [neglect of public works]. The communication between Calcutta and the Ganges is by two canals. One of these, called the Eastern Canal, has long been closed, so that the native traffic of this large city (stated in the railway pamphlets at two million tons a year) is confined to the other. Its length is 2½ miles, and its condition is such, write the Association, *that it ordinarily takes* 9, 11, *and even* 13 *days to effect a passage through it.* They further go on to state that the road to it is so blocked up, that it cannot be got at; that the canal is in such a foul and fœtid state as to be highly injurious to public health; that the tolls yield a large surplus revenue to Government; and that heavy demurrage rates have been established on boats remaining more than two days in the canal, though, owing to the neglect of Government, it is in such a state that it takes from 9 to 13 days to pass through it."

This is represented to be the state of things in the case of a work under the very eyes of the Government, and through which the whole trade of Calcutta with the interior passes.

By the same mail also it is reported that one short step has at length been taken in the right direction. A loan of 2¾ millions has been opened, to be expended in public works in India.

We give some citations from a letter by Mr. Bourne on the subject of Indian River Navigation, addressed to the Secretary of the Society of Arts; and at pages 145, 150 of our vol. viii. for 1850 will be found a long and very interesting account of Mr. Bourne's plans for opening up internal communications in India, and so developing the immense agricultural and other resources of that great country. Those interested in the subject, and desiring fully to understand the views expressed in the present letter, would do well to refer to the paper in vol. viii.

Mr. Bourne is known to have paid great attention to this question from a very early period of its discussion, and has written frequently and ably thereupon.

At page 129, vol. viii., 1850, will be found some remarks upon the present question, in a notice of Mr. I. Chapman's pamphlet upon the great Indian Peninsula Railway, which, as connected with the subject of Colonel Cotton's paper, merits re-perusal.

"Greenock, April 5th, 1855.

"* * * The great want in India is the want of internal communications. All parties are agreed upon that. This want may be relieved by the construction of roads, and railways, and canals, and also by improving the navigation of the rivers already subsisting in that country. Now, India is so vast a country, that to cast over it such a network of roads, or railways, or canals, as would effectually or largely subserve the purposes of internal communication, would cost a larger sum of money than could readily be collected for that purpose; and if we rely wholly on these instruments of amelioration, we cannot expect to make any very large progress in improving the internal communication of the country for a number of years. No doubt, roads, railways, and canals should be made, so far as we have the means of making them, in all those situations in which improved communications are very desirable, and in which there is no cheaper expedient available for satisfying the want; and the selection of the particular kind of road which should be adopted must depend upon local circumstances, as, indeed, will be obvious to every one. The rivers, which in other great tracts of country are the main arteries of internal communication, are in India so shallow and so full of sandbanks, that to navigate them by steam-vessels of the kind commonly employed in other countries is impossible, or, at least, possible only to a very limited extent; while to deepen those great and shifting rivers, so as to render them suitable for navigation by steam-vessels of the ordinary form, would, as a general rule, be a far more costly operation than to construct contiguous lines of railway or canal. Although, however, we cannot expect to adapt the rivers of India to our familiar modes of navigation, it became obvious to me, from my investigations in India, that to construct vessels which should be of such a character as to be capable of navigating the shallow and shifting rivers of India, was a problem by no means beyond the power of engineering science to solve. On the contrary, it appeared to me that the construction of such vessels would be by no means a difficult achievement. If such rivers had existed in England, I felt persuaded that they would have been effectually navigated by steam long ago; and the only reason to which I could attribute the circumstance of their not being so navigated, was that few mechanical engineers had ever visited India, or were acquainted with the peculiarities of the rivers of that country, or were cognisant of the vast extent of country which any effectual expedient for navigating them would open up. I calculated that by establishing upon the rivers of India steam-vessels of light draft, and of otherwise suitable construction, to overcome the difficulties of the navigation, about *ten thousand miles* of river would be opened to navigation by steam, without doing anything to improve the rivers at all. No doubt, it would be found expedient to remove impediments out of the beds of some of the rivers at certain points; but this improvement, though desirable, was not necessary, and by the simple expedient I have mentioned, about ten thousand miles of great steam highway would be obtained, without any other expense than the construction of the steamers necessary to run upon it. * * *

"It would swell this letter to inconvenient dimensions, if I were to enter into any detailed description of the particular rivers of India which are navigable throughout the year, of the distance from the sea to which they are navigable, or of the particular species of vessel by which their navigation may be accomplished. I may mention, however, that the Ganges and Jumna, and some of their chief tributaries, are navigable to within a comparatively short distance of the point from whence they issue from the Himalaya and the Indus; and other great rivers of the Punjaub are navigable up nearly to a chain of mountains called the Salt Range, situated not far distant from the range of the Himalaya. The Mahanuddy, Godavery, and some other rivers of Southern India, are navigable also through a considerable part of their course. The rivers flowing from the Himalaya to the sea, being fed by melting snows, have much water in them in the height of summer; and most of the great rivers of India take their rise in this great mountain range.

"It will be seen from this general explanation of my views respecting the internal communications of India, that they are, as I believe, identical with those so effectively propounded by Colonel Cotton; and although there may be differences of opinion upon small points among those discussing the accuracy of his views, I believe that his main propositions cannot be controverted. Whatever we may think of the respective merits of railway and river transport, I think we must come to the conclusion that as we have not got the railways to any considerable extent, but have got the rivers which we can largely use without any expense but that of the locomotive power, we ought in the mean time to use the rivers as far as possible; and should the river communication be in time superseded by a railway, there is no loss involved in inconvertible works, but we have merely to shift the steam-vessels to some other river where no railway competition yet exists. It does not appear probable, however, that the existence of railways in India will supersede water conveyance, since it has not been found to do so in other countries. In 1846, when I drew up the traffic estimates of the East Indian Railway, I found that, unless it acquired a large proportion of the Ganges traffic, it could not be expected to be remunerative, and that it could not expect to acquire this traffic if the charge was more than 1d. per ton per mile. In the estimates made at the same time, by Mr. Chapman, for the Bombay Railway, and for which at that period no river competition was apprehended, the charge set down for goods was 2¾d. per ton per mile; and I presume the charge would be kept up to this amount, or up to such an amount as would suffice to compete with land carriage, unless a water conveyance were opened from Berar to the coast by the Godavery, which will afford the only assurance that can be got that cotton will continue to be conveyed to the coast at a cheap rate. If this cannot be done, then the supporters of the railway cannot be damaged by the experiment. If it can be done, as from their opposition to the project the railway advocates appear secretly to believe, then the public will be gainers by the increased cheapness of transport thus obtained.

"From all I saw or could learn of the rivers of India while engaged in engineering operations in that country, and from all the information I have been able to obtain as to the expedients in successful use for navigating rapid and shallow rivers in other parts of the world, I have, I think, accumulated sufficient evidence to enable me to state with confidence that a large portion of the rivers of India may be navigated by steam in such a manner as greatly to accelerate and cheapen the internal communications of that country, and these benefits may be realised without delay, and at a small expense. I believe that improved communication must precede improvements calculated to increase production, else a market cannot be obtained for the additional articles produced; and to the same extent to which new outlets are afforded to Indian productions, will new inlets be afforded to British manufacture.

"I am, Sir, truly yours, J. Bourne."

ON EARTH-BORING MACHINERY.*

By Colin Mather.

The object of the present paper is to describe the various modes of boring Artesian wells, or, in other words, of earth-boring, which has become a matter of considerable importance in relation to several objects of public utility and of private enterprise.

When the country was thinly inhabited, the water supplied by surface springs and rivers was found sufficient for the ordinary wants of human life; but when population increased, and the land came more into cultivation, the supply decreased as the demand increased, and it was found necessary to obtain additional supplies of water by digging artificial wells. In course of time, as manufacturing processes were developed, and large cities grew up, other resources had to be created. Among various plans which might be mentioned, the formation of Artesian wells has been resorted to in modern times, and with considerable success.

In the sinking of wells, and especially wells of this description, improvements in the art of boring become peculiarly interesting and valuable.

Among the various systems and applications which have been adopted, one well-known method of boring is to attach the chisel to a series of rods, which

* Paper read before the Society of Arts, May 30, 1855.

are suspended from the end of a spring-pole. The workmen, taking their stand at the end of the pole, give the vibratory motion, which raises the rods after a stroke has been given, whilst others turn the bar, causing the chisel to strike upon a fresh place, and so gradually to penetrate the earth. When the *débris* has accumulated so as to obstruct the progress of the chisel, the rods are withdrawn by means of a windlass, each one being unscrewed as it is wound up; when the last rod is raised, the chisel is detached, and the shell for collecting the *débris* is substituted; this is then lowered by means of the windlass, one rod after another being screwed on till the shell has reached the bottom.

The shell is a tubular instrument, of sheet-iron, usually from three to four feet long, something less in diameter than the size of the hole, with a clack at the bottom. This is plunged into the *débris*, and what HAPPENS to get into the shell and above the clack is then brought to the surface, assuming the clack to close as it is designed to do, by winding and unscrewing as before.

Another method of boring is to give the impulsive motion by means of a windlass, which has a rope coiled a few times round the barrel; one end of the rope is attached to the boring-rod, and the other is held by the workman, who draws the rope tight. The windlass being then slightly turned, the friction upon the barrel being sufficient to enable the workman to hold the rope, the rods are raised a sufficient height to give the required stroke. The workman then slacks the rope suddenly, when the coils become loose, and the rods descend with a force equal to the motion derived from their own weight and the distance through which they have to fall. This method is generally resorted to when the weight of the rods is so great as to overcome the elasticity of a spring-pole.

A third method is that described by Mr. Vignoles, in a paper read at a meeting of the British Association, and which appeared in the *Mining Journal* of September 26th, 1846.

Mr. Vignoles says—"The apparatus is composed of a hollow boring-rod, formed of wrought-iron tubes screwed end to end; the lower end of the hollow rod is armed with a perforating tool, suited to the character of the strata which have to be encountered. The diameter of the tool is larger than the diameter of the tubular rod, in order to form around it an annular space through which the water and the excavated material may rise up. The upper end of the hollow rod is connected with a force-pump by jointed and flexible tubes, which will follow the descending movement of the boring-tube for an extent of some yards. This boring-tube may be either worked by a rotary movement with a turning handle, or by percussion with a jumper. The frame and tackle for lifting, lowering, and sustaining the boring-tube offer nothing particular. When the boring-tube is to be worked, the pump must be first put in motion. Through the interior of the tube a column of water is sent down to the bottom of the bore-hole—which water, rising in the annular space between the exterior of the hollow boring-rod and the sides of the bore-hole, creates an ascending current which carries up the triturated soil; the boring-tube is then worked like an ordinary boring-rod; and as the material is acted upon by the tool at the lower end, it is immediately carried up to the top of the bore-hole by the ascending current of water. It is a consequence of this operation that the cuttings being constantly carried up by the water, there is no longer any occasion to draw up the boring-tube to clear them away—making a very great saving of time. Another important and certainly no less advantage is, that the boring-tools never get clogged by the soil; they work constantly (without meeting obstructions) through the strata to be penetrated, thus getting rid at once of nine-tenths of the difficulties of boring."

The writer of this paper admits that the wonderful results of this machine, contemplated in the report from which the above extract is taken, caused him at that time to pause in proceeding further with his experiments on earth-boring. After patiently waiting from September, 1846, till May, 1848, without hearing of the method of boring thus favourably described being carried into execution, he wrote the following letter to the editor of the *Mining Journal*:—

"Sir,—I should be extremely obliged if you, or any of your correspondents, would inform me what progress Fauvelle's new system of boring has made in this country. I have been anxiously looking and waiting for some marvellous result ever since your number of the 26th September, 1846. It was also stated in your journal of the the 5th December, 1846, that the Pennant Lead and Copper Mining Company had made arrangements to test its capabilities.

"If you could return answers to the following questions, it would be deemed a favour by many of your readers and correspondents:—Whether, in the first place, the trial alluded to ever took place; and, if so, what has been the result? Or, if it is still going on, what are the expectations it holds out? And, lastly, the address of the parties who have it in hand.

"*Manchester, May 11th.*"

As no answer appeared, it was taken for granted that the whole description corresponded with a statement in the same report, "That the weight of a hollow rod, three inches in diameter, and the iron a quarter of an inch thick, would be *less* than that of a solid rod of an inch diameter."

At the present time a well is being bored at Highgate by MM. Degousée, probably the most experienced and extensive borers known. Great praise is due to them for the liberal way in which they publish their proceedings and explain their apparatus. Their method differs but little in principle from that generally used in this country, except in the employment of steam-power for raising and lowering the rods, and for giving the percussive motion to the cutters; and, further, in the great variety and superior make of their implements. Perhaps the greatest novelty of their system is that, instead of the spring-pole or the windlass, they use a lever, the motion being applied to one end of the lever, and the rods attached to the other. A counterbalance is attached at the motion end of the lever, partly to counterpoise the great weight of the rods.

A great deal has been said about the Chinese method of boring with a rope, but sufficient details have never reached this country to enable that method to be carried into practice here.

Having thus briefly described the methods of boring now in general use, it is next proposed to explain the new and improved plan just being brought into operation.

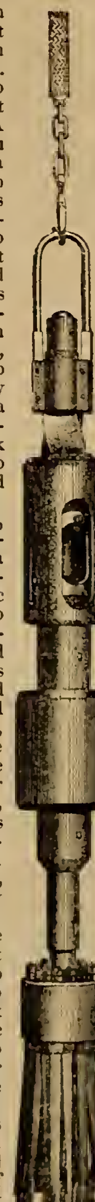
The construction of the boring-head and shell-pump, and the mode of acquiring the percussive motion, constitute the chief novelties of the system and machine. The couple-cylinder engine, with the reversing or link motion, is used for winding and lowering apparatus; but an ordinary winding engine, similar to those used in collieries, may be applied.

The boring-head consists of a wrought-iron bar, about eight feet long, on the lower part of which is fitted a block of cast-iron, in which the chisels or cutters are firmly secured. Above the chisels an iron casting is fixed to the bar, by which the boring-head is kept steady and perpendicular in the hole. A mechanical arrangement is provided, by which the boring-head is compelled to move round a part of a revolution at each stroke. The loop or link by which the boring apparatus is attached to the rope is secured to a loose casting on the wrought-iron bar, with liberty to move up and down about six inches. A part of this casting is of square section, but twisted about one-fourth of the circumference. This twisted part moves through a socket of corresponding form on the upper part of a box, in which is placed a series of ratchets and catches, by which the rotary motion is produced. Two objects are here accomplished—one the rotary motion given to the boring-head, the other a facility for the rope to descend after the boring-head has struck, and so prevent any slack taking place, which would cause the rope to dangle against the side of the hole, and become seriously injured by chafing.

The shell-pump is a cylinder of cast-iron, to the top of which is attached a wrought-iron guide. The cylinder is fitted with a bucket similar to that of a common lifting-pump, with an India-rubber valve. At the bottom of the cylinder is a clack, which also acts on the same principle as that in a common lifting-pump, but it is slightly modified to suit the particular purpose to which it is here applied. The bottom clack is not fastened to the cylinder, but works in a frame attached to a rod which passes through the bucket, and through a wrought-iron guide at the top of the cylinder, and is kept in its place by a cotter, which passes through a proper slot at the top of the rod. The pump-rod, or that by which the bucket is worked, is made of a forked form, for the twofold purpose of allowing the rod to which the bottom clack is attached to pass through the bucket, and also to serve as the link or loop by which the whole is suspended.

The wrought-iron guide is secured to the top of the cylinder, and prevents the bucket from being drawn out when the whole is so suspended. The bottom clack also is so arranged that it is at liberty to rise about six inches from its seating, so as to allow large fragments of rock, or other material, to have free access to the interior of the cylinder when a partial vacuum is formed there by the up-stroke of the pump.

The percussive motion is produced by means of a steam-cylinder, which is fitted with a piston of 15 inches diameter, having a rod of cast-iron 7 inches square branching off to a fork in which is a pulley of about three feet in diameter, of sufficient breadth for the rope to pass over, and with flanges to keep it in its place. As the boring-head and piston will both fall by their own weight when the steam is shut off, and the exhaust-valve opened, the steam is admitted only at the bottom of the cylinder; the exhaust-port is a few inches higher than the steam-port, so that there is always an elastic cushion of steam of that thickness for the piston to fall upon.



BORING-HEAD.

SHELL-PUMP.

The valves are opened and shut by a self-acting motion derived from the action of the piston itself; and as it is of course necessary that motion should be given to it before such a result can ensue, a small jet of steam is allowed to be constantly blowing into the bottom of the cylinder: this causes the piston to move slowly at first, so as to take up the rope, and allow it to receive the weight of the boring-rod by degrees, and without a jerk. An arm which is attached to the piston-rod then comes in contact with a cam, which opens the steam-valve, and the piston moves quickly to the top of the stroke. Another cam, worked by the same arm, then shuts off the steam, and the exhaust-valve is opened by a corresponding arrangement on the other side of the piston-rod. By moving the cams, the length of the stroke can be varied at the will of the operator, according to the material to be bored through. The fall of the boring-head and piston can also be regulated by a weighted valve on the exhaust-pipe, so as to descend slowly or quickly, as may be required.

The general arrangement of the new machine may be described as follows :—

The winding drum is 10 feet in diameter, and is capable of holding 3,000 feet of rope, 4½ inches broad and half an inch thick; from the drum the rope passes under a guide-pulley, through a clam and over the pulley which is supported on the fork end of the piston-rod, and so to the end which receives the boring-head, which being hooked on and lowered to the bottom, the rope is gripped by the clam. A small jet of steam is then turned on, causing the piston to rise slowly until the arm moves the cam, and gives the full charge of steam; an accelerated motion is then given to the piston, raising the boring-head the required height, when the steam is shut off, and the exhaust opened in the way described, thus effecting one stroke of the boring-head as regulated by a back-pressure valve in the exhaust-pipe. The exhaust-port is six inches from the bottom of the cylinder; when the piston descends to this point, it rests on a cushion of steam, which prevents any concussion. To increase the lift of the boring-head or compensate for the elasticity of the rope, which is found to be one inch in one hundred feet, it is simply necessary to raise the cams on the cam-shaft whilst the percussive motion is in operation. The clam which grips the rope is fixed to a slide and screw, by which means the rope can be given out as required. When this operation is completed, and the strata cut up by a succession of strokes thus effected, the steam is shut off from the percussive cylinder, the rope unclamped, the winding-engine put in motion, and the boring-head brought up and slung from an overhead suspension bar by a hook fitted with a roller to traverse the bar. The shell-pump is then lowered, the *débris* pumped into it, by lowering and raising the bucket about three times, which the reversing motion of the winding-engine readily admits of; it is then brought to the surface and emptied by the following very simple arrangement. At a point in the suspension-bar a hook is fixed perpendicularly over a small table in the waste-tank, which table is raised and lowered by a screw. The pump being suspended from the hook hangs directly over the table, which is then raised by the screw till it receives the weight of the pump. A cotter, which keeps the clack in its place, is then knocked out, and the table screwed down. The bottom clack and the frame descending with it, the contents of the pump are washed out by the rush of water contained in the pump-cylinder. The table is again raised by the screw, and the clack resumes its proper position; the cotter is then driven into the slot, and the pump is again ready to be lowered into the hole as before. It is generally necessary for the pump to descend three times in order to remove all the *débris* broken up by the boring-head at one operation.

The following facts obtained from the use of the machine in boring in the new red sandstone at Manchester will show its actual performance, and enable us to compare it with the other systems mentioned in this paper. The boring-head is lowered at the rate of 500 feet a minute; the percussive motion is performed at the rate of 24 blows a minute, and being continued for 10 minutes, the cutters in that time penetrate from 5 to 6 inches; it is then wound up at 300 feet a minute. The shell-pump is then lowered at the rate of 500 feet a minute, the pumping continued for one minute and a half, and being charged, the pump is wound up at 300 feet a minute. It is then emptied, and the operation repeated, which can be accomplished three times in 10 minutes, at a depth of 200 feet. The whole of one operation, resulting in the deepening of the hole 5 to 6 inches, and cleansing it of *débris* ready for the cutters or boring-head being again introduced, is seen to occupy an interval of 20 minutes only. The value of these facts will be best shown by comparing them with the results by the old method.

At Highgate the boring has occupied two years in attaining a depth of 680 feet from the bottom of a well 500 feet deep from the surface. Their progress at present is at the rate of 6 inches per week, working night and day. At Warwick, 13 months were occupied in boring 400 feet through red marl; at Saltaire, two years in going 80 yards.

One well-known defect of the old method of boring consists in the "buckling" and dangling of the rods, which has the effect of enlarging the hole in some instances to a diameter of four feet where soft strata intervene. This arises from the buckling and dangling of the rods causing them to strike against the sides of the hole, and breaking off portions of earth which fall to the bottom, thus considerably increasing the quantity of *débris* to be brought up by the shell, and occupying an immense time in getting out the *débris* which has merely fallen from the side, without increasing the depth of the hole. This is a serious defect where geological purposes are to be served by the boring, because the earth from the side falling to the bottom of the hole mixes with that which is cut up by the chisel, and thus prevents an accurate knowledge being obtained of the strata which the boring has penetrated. It must be remarked also that the defect of buckling is to crystallise the iron, deteriorating its quality, and thereby causing those frequent breakages which retard progress, and add so materially to the expense of this system of boring. The process of crystallisation being beyond the observation of the workmen, the result is scarcely if ever known till the breaking of the rods reveals it. To remedy this difficulty, and obviate the effects of buckling, it has been found necessary to put down iron tubes into the bore-hole. As the first length of these tubes can scarcely be got to a depth of more than 200 feet, on account of the great external friction, it is necessary, when the tube has to be carried to a further depth, to put down a second and a third length of tube; and as each length must come to the surface, the diameter of the bore-hole is very materially diminished. It will easily be seen that when the bore-hole is required to be of considerable depth, this diminution of its diameter will at length so contract the hole as to render the supply of water comparatively limited, and, in fact, to threaten the design with actual failure, after a vast outlay has been incurred. These inconveniences, so serious in character, are all obviated by the new method of boring. No rods are used; and as the rope which is substituted for them seldom comes in contact with the sides of the hole so as to disturb the strata, tubing will rarely be required. Indeed, it will only be necessary when the particular strata through which the hole passes happens to be very fluid; and even then it will not always be wanted. The great power of pumping and the facility of winding possessed by this new machine would enable it to exhaust any ordinary quicksand which might find its way into the hole. The pumping process could be carried on at a depth of 500 feet, at the rate of a cart-load per hour. It is possible with the improved machine to cleanse the hole so effectually that not a loose particle remains at the bottom. This will at once be seen from the fact that the pump has sufficient power to draw in masses of rock or other substances of from three to four pounds weight. This circumstance renders the machine particularly useful in geological researches, inasmuch as the lowest strata are brought up in a state of the greatest possible compactness and purity, notwithstanding any admixture of earth from the sides, or of that which the shell has been unable to bring up in the previous operation.

Some of the more important public uses to which the new machine can be applied may now be briefly enumerated.

Sanitary questions deservedly occupy at the present time a large share of public attention Water, as is well known, is the chief agent in sanitary reform. It is necessary for flushing sewers, for supplying baths and wash-houses, as well as for meeting the domestic wants of all classes of the community. The importance of cleanliness cannot be overrated, as a means of promoting the general health, and it imposes the necessity for a much more copious supply of pure water than is as yet enjoyed in most towns. Many small towns which are so situated that they cannot command a supply of water from natural sources, are prevented from obtaining it by boring, on account of the great expense, and still more the vexatious uncertainty of the process. The Corporation of Manchester have expended upwards of a million sterling in supplying that city and its neighbourhood with water, and they sell it to the Corporation of Salford at the rate of threepence per thousand gallons. It is confidently believed that by the new method of boring, an abundant supply of water could be procured on the spot at half that price. Thus, in a sanitary point of view, the new machine is of the utmost value, since it enables us to procure a much greater supply of water in far less time, and from depths which were all but inaccessible on the old method of boring. For example, the work at Highgate, which has occupied two years, could have been done in thirty-three days. That at Warwick, which has occupied thirteen months, could have been done in twenty days. That at Saltaire, to supply the workpeople with drinking water, which has occupied two years, could have been done in twenty-nine days.

It must be borne in mind that water is seldom sought by the tedious and expensive process of boring till it is urgently wanted. The old method, therefore, not only occasions a vastly increased outlay, but also involves an amount of privation which in many cases is a matter of serious importance.

In conclusion, another important use may be noticed to which this invention may be applied—namely, the ventilation of mines, with a view of preventing the dreadful explosions which are unhappily too frequent. These explosions most frequently arise from the ignition of the gases or foul air accumulated in the galleries, or old workings, and in large cavities which have been partitioned off. The remedy in these cases would be to bore down from the surface and perforate these parts of the mine at different places, so as to admit a current of fresh air into the parts where the foul air had accumulated. On the old method of boring this object is impracticable, since, in addition to the expense, the diameter of the hole within reach of the old system is quite insufficient for the purposes required. The improved plan now proposed is not only (as has been shown) much more economical, but it is capable of boring holes of ample dimensions to be adapted as air-shafts in the way proposed. A diameter of three feet has been suggested above, but the largest practicable limit is much beyond this. Instead of partitioning off the winding-shaft, and connecting it below with a complicated system of passages for return currents, it would be found in practice much more useful to bore several holes, of a moderate diameter, at the end of the workings. On this plan the air would have only half the distance to travel, and the ascending shaft would not require to be kept at nearly so high a temperature; or, if kept at the same temperature, the ventilation of the mine would become so much the more effective and complete.

It is hoped that the facts contained in this paper will sufficiently prove the vast superiority of the new method of boring herein described, and the great advantage which will accrue to the community from its general adoption. Relying upon these facts, it is presumed by the inventor that the improvements he has introduced will constitute a new era in the art of earth-boring, and in the various important objects to which it is and may be applied.

The following certificates have been kindly given, confirming the statements above made respecting the actual performance of the machine:—

[COPY.]

"Town Hall, Salford, Borough Treasurer's Office, March 22nd, 1855.

"*To Messrs. Mather and Platt, Engineers, Salford Iron Works.*

"GENTLEMEN,—I have pleasure in certifying to the amount of cutting done by your admirable and highly-ingenious earth-boring machine, during my visit at your establishment this day.

"The bore-hole was 15 inches diameter and 205 feet 3 inches deep when the machine was set to work; the operations of lowering, working, and raising the boring-head, and of lowering, working, and raising the pump, and the broken rock, occupied nineteen and a half minutes. The depth of the hole was again measured, and found to be 205 feet 10 inches; showing that the machine had cut the red rock and brought to the surface *seven inches* in depth.

"The machine appears to me to be exceedingly well adapted for the performance of the work it has been constructed to perform, and being worked by a steam-engine requires the attention of only two persons.

"The work performed in my presence is equal to 21½ inches per hour, or about 18 vertical feet per day of ten hours.

"The following is the actual time occupied in each movement of the machine:—

Lowering boring-head	1½ minutes
Boring	10 "
Drawing up boring-head	1½ "

Lowering pump 1st time	.. ..	$1\frac{1}{2}$ minutes.
Drawing up pump and broken rock	.. ..	1 ,,
Lowering pump 2nd time	.. ..	1 ,,
Drawing up pump 2nd time	.. .. ..	1 ,,
Loweriug pump 3rd time	.. ..	1 ,,
Drawing up pump 3rd time	.. .. ..	1 ,,
Total time	.. ..	$19\frac{1}{2}$ minutes.

"Vertical depth bored through red rock in well 15 inches diameter, *seven inches*; being at the rate of $21\frac{1}{2}$ inches per hour, or about six vertical yards per day of ten hours.

"E. R. Langworthy, Alderman and Justice of the Peace."

"I was present during the above-mentioned operations, and took the time of working Messrs. Mather and Platt's extraordinary machine, which is correctly stated above.

"David Chadwick, Treasurer of the Borough of Salford."

RECENT AMERICAN INVENTIONS.

We are indebted to the "Scientific American" for illustrations of recent American inventions given this month. Plate xliv. illustrates the several inventions to which we now call special attention.

Tyson's Propeller for Vessels.—This propeller consists of inclined blades secured to a hub; the peripheries of the blades are everywhere equidistant from the axis on which the propeller turns, and are furnished throughout their whole extent with rims, which have the form of helical strips cut from the barrel of a cylinder, and project backwards from the blades to confine the water on which the latter is acting, to prevent it from being thrown outwards by the centrifugal force generated by the revolution of the blades.

a a are the propeller-blades, each consisting of a plate of metal secured in an inclined position to a central hub, which is made fast to the propeller-shaft. Each blade is straight-edged at its front, *a*, or that end which enters the water; their hind edges are curved, as represented at *b*. The outer edge, or periphery, of each propeller is at every point equidistant from the axis of the shaft, so that in revolving it will describe a cylinder, of which the axis of the shaft is the axis. The periphery of each blade is fitted with a rim, which projects behind it; this rim has the form of a strip cut from the cylinder described by the rotation of the blade. It confines the water upon which the blade is acting, and prevents it from being thrown outwards by the centrifugal force which is generated by the rotation of the blades, and thus allows of the propeller being made with a greater pitch than those in general use, while at the same time it opposes but little resistance to the forward movement of the vessel.

The object for which this propeller is designed, is the propulsion of vessels; and it is believed to be peculiarly fitted for canal navigation, as the rims of the blades, by retaining the water, prevent it from moving laterally from the propeller-shaft, and thus prevent the production of waves which act injuriously upon the banks.

This propeller is now in successful operation on the canal-boat *Isaac Eckert*, Capt. Thos. Armitage, of Manayunk, Pa., who has tried several others, and who says this is the best he has ever used.

Perry's Breech-loading Fire Arms.—Fig. 1 is a perspective view of the improvement with the breech-lever down, showing the breech and nipple, and the open butt of the gun-barrel. Fig. 2 is a segment-piece drawn back from the breech in position for loading; and Fig. 3 represents the breech closed by the segment-piece. Similar letters refer to like parts.

The nature of the invention consists in the peculiar and effectual mode of closing the breech of the gun after the cartridge has been inserted, providing most effectually against the escape of the gas and the recoil of the breech-piece under the effect of the discharge, by a segmental revolving breech-piece like the one shown, in which there is a cylindrical or conical projection on its face to enter the bore of the barrel, when the plane surface of the breech-piece is brought up in contact with the rear of the bore of the barrel, and having a circular surface fitting in a corresponding recess at its rear, as combined; also a peculiar combination and an arrangement of parts for the purpose of holding this peculiar breech-piece firmly in place during the discharge.

The segment-piece, *a*, turns upon the centre, *b*, within a slot, *s*, in the gun-stock, and has upon its face a projection, P, to enter and fit the open end of the barrel, as seen in Fig. 3. In the centre of this projection is a raised nipple, *d*, and around this nipple a slight depression, *d'*. The fire from the cap enters the charge through the centre of this nipple; and the purpose of this nipple is to concentrate the fire upon the charge, in consequence of the nipple's being forced slightly within the surface of the end of the cartridge.

The segment-piece is worked on and off the breech of the barrel by means of the cam-levers, *g*, *h*, and the hand-lever, *i*. The hand-lever is provided with a spring latch, *m*, to secure it in place by a catch. The lever *g* is jointed to the segment-piece within a slot, *g'*, in the same; and the lever *h* is jointed to lever *g*, within a slot, *g''*, in this lever; and the lever *h* is also jointed to lever *i*, within a slot, *i'*, in this lever.

There is a notch and projection at *h'* on lever *h*, which bears upon the end of the lever *g*, when the segment commences to move towards closing the barrel; but as the segment advances, it will be seen from the Figures 2 and 3 that lever *g* changes its relation to *h*, the end of *h* bearing upon the side of *g*, and pushing its lower end into cavity *k*, in the gun-stock. The extremity of *g* bearing upon the side of cavity *k*, is so made and moved as to wedge itself as it advances, and thus forces the segment-piece firmly against the breech of the barrel, and holds it in place. The parts around and below the projection, *p*, are cut away so as to leave room for grit or dirt to fall out of the way of the fitting parts. The operation of the segment-piece is simple; and from the small number of parts, and their relation, arrangement, and operation, the work keeps clean and in order.

Messrs. Stouffer, Brough, and Barr's Patent Improved Apparatus for Flouring and Bolting.—Fig. 1 is an elevation of the machinery, and Fig. 2 is a transverse section. Similar letters refer to like parts.

The nature of the improvement consists in entirely separating the bran and the flouring particles previous to subjecting the stuffs to regrinding, by passing them through the superfine bolt, A, and then through a second one, B, under it.

On the reception of the ground grain raised by elevators to the spout D, it is received in the first bolt, A; all flour of superfine quality is deposited under the head of this bolt, and conveyed to the packing-chest by spout R, while the fine flour intermixed with specks is deposited in the screw-box N, over the draw-gates, 1, 2, 3, 4, 5, 6, and conveyed by bent tubes, E E, under and across the second bolt into the screw-trough F, from whence it is conveyed and mixed with the stuffs from the first burrs by the spout G, to be raised and rebolted in the first bolt, at the head of which it deposits a still further quantity of superfine flour. The specky flour having been thus rebolted, all that passes through the coarser mesh of the lower bolt, B (it being covered with superfine cloth only half-way), is conveyed by the open spout, S, and screw-trough, H, to the auxiliary mill, *c*, by spout I. Under the head of the lower bolt, B, in the screw-trough M, a draw-gate, 7, is placed, which may be opened and delivered into the screw-trough F, below, when the flour is of quality to justify its rebolting. The brown stuff received at the tail of the bolt is delivered by screw M into the lower spout, K, on the end, while the bran passes out by the spout L, placed above it, communicating directly with the lower end or tail of the second bolt, B. The stuffs reground by the auxiliary mill are taken by elevators, *o o* (exhibited in dotted lines in Fig. 2), to the lower bolt only, being delivered into the spout P. Any superfine flour from them is deposited on the gate, 7, at the head of this bolt, B, and falling through, is mixed with that passing through the several gates under the bolt A. The advantages of this improvement are set forth in the specification, as follows:—"In the bolting process and apparatus, an insignificant quantity of brown stuff is made (which is only bran ground fine), and avoiding entirely the production of middlings, at the same time increasing the production of superfine flour of uniform quality or brand; with good wheat, a barrel being produced from four bushels to four bushels and six pounds.

"The practical use of the improvement may be thus explained:—When the quality of wheat justifies it, and the run of the first bolt shows no specky matter mixed with the flour, all the gates, 1, 2, 3, 4, 5, 6, may be closed, and of course the screw will deliver by spout R into the packing-chest or barrel; but should the specks show under this bolt, draw or open the gates, 6, 5, 4, &c., in accordance with the appearance. Indifferent qualities of wheat may require nearly all the gates to be opened; but there is this advantage gained, there is not that necessity for a low grind (by which quality is sacrificed for appearance) to accomplish the end proposed, viz., to make the most uniform quality, by which the character of the brand is sustained without loss of quality in product of superfine flour from the bushel of grain, at the same time avoiding loss of power, and the production of middlings and offal."

It is also stated in the specification, that all efforts heretofore made to produce a barrel of superfine flour from less than 4 bushels and 25lbs. of wheat have failed to procure a regular run of quality, on account of the bran-husk being reground with the farina, and imparting a red cast to the flour. The regrinding of all the offal, on account of gluten, has also a tendency to clog the bolts. The great quantity of bran, also, in proportion to the flour which is passed through the auxiliary mill, consumes a great deal of power.

Nordyke and Hunt's Patent Wire Cloth Flour Bolt.—This seems a very complete apparatus. The various parts are described as follows:—

Figure 1 is a longitudinal section of the flour-bolt—the plane of section being through the centre; and Fig. 2 is a detached section of the device by which the pressure of the brushes against the wire cloth of the bolt is graduated.

The nature of the invention consists in the peculiar device employed for expanding and contracting the rotating brushes which act against the inner surface of the wire cloth of the bolt, and force the flour through; the brushes bearing against the wire cloth with a greater or less pressure, according as they are adjusted.

A represents a wire-cloth bolt of the usual cylindrical form, which is placed stationary within a chest or box, B, the bolt being formed of cloth of different degrees of fineness, as indicated by 1, 2, 3, 4, and 5.

C represents a shaft which runs longitudinally through the centre of the bolt, A, and has its bearings, *a a*, on the framing of the chest or box, B. On one end of this shaft, at the head of the bolt, there is placed a driving pulley, D. At each end of the shaft, C, there is permanently secured a hub, *b*, having radial arms, *c*, projecting from it, the ends of said arms being forked, and having bars, E, loosely fitted in them, on the outer ends of which bars, brushes, F, are secured.

On the outer edges of the arms, *c*, and near their ends, are slides, G, one to each arm, said slides working within small guides, *d*, attached to the arms, *c*. The outer ends of the slides, G, are attached to the brush-bars, E, and the inner ends are attached by pivots, *e*, to the upper ends of arms, H, the lower ends of said arms being secured by pivots, *f*, to a hub, I, placed loosely on the shaft, C. The hubs, I I, are kept in proper position upon the shaft, C, by a small rod which passes through one of the hubs, *d*, of the arms, *c*, and through the hub, I, this hub being prevented from moving by nuts, *h h*, on the rod, which nuts are at each side of an ear, *l*, on the hub, I, Fig. 3.

J, Fig. 1, is a rod which passes through both of the hubs, I I, and having a screw-thread cut on its inner end working on the hub, I, at the head of the bolt.

K are spouts, or rather the divisions of spouts, which are attached to the lower ends of hoops or rings, L L, which encompass the bolt, A. To these divisions, K K, there are attached slides, M M, one to each, the slides projecting through the chest or box, B, at the tail of the bolt. The divisions, K K, and hoops or rings, L L, form perfect divisions or compartments within the chest or box, B, and prevent the flour from one division passing into the other. The lower ends of the divisions, K K, are formed each of two parts, *k k*, the upper ends of which are attached by straps or hinges, *l*, to projections, *m*, secured to the lower parts of the hoops, the lower ends of the two parts of each division fitting over triangle projections, *n*, at the bottom of the chest or box, B, the lower ends of the parts, *k k*, being kept against the projections by spiral springs, *o o*. The hoops or rings, L L, on their inner edges are provided with india-rubber strips, *p*, in order to make a tight joint between the bolt-frame and hoops or rings. The outer edges of the upper halves of the hoops or rings are also provided with strips, *p*, as also the edges of the division-plates, K.

Operation.—The meal or unbolted flour is admitted into the head of the bolt, A, which is elevated about one inch to the foot, and motion being given the shaft, C, the flour is brushed through the bolt or wire cloth by the brushes, F, the pressure of said brushes against the wire cloth being graduated as desired by operating the rods, *g* J, by which the nuts, I I, on the shaft, C, may be moved, and the brush-bars, E, expanded or contracted. The finest flour falls through the portion of fine wire cloth, numbered 1 and 2, and by moving the slide to which the first division-plate, K, is attached, the flour receptacle is enlarged or contracted, so that only the first quality may be received in the flour receptacle. The same operation may be applied to the plate K.

By the use of the sliding division-plates, the flour may be separated at varying points, as also the ship-stuff, and inferior boltings towards the tail of the bolt. And as wheat differs much respecting the quality and quantity of good flour it will produce or yield, the division-plates may be adjusted accordingly, so as to keep the fine portion separate from the rest.

BROWN'S IMPROVED SAW MILL.—The following description is of an invention patented by Mr. Isaac Brown, of Baltimore, and merits attention. A is the engine-frame, also answering for fender-posts to saw-mill. B are cross-heads, also saw-gate sliding against fender-posts. C are saws strained between the cross-heads or in saw-gate. D is the steam-cylinder, firmly bolted between the fender-posts, with piston-rod extending through both heads of the cylinder, resting between top and bottom cross-girts of the saw-gate in substantial bearing surfaces, E, leaving the ends of the piston-rod unrestrained to work in line with the cylinder, and with freedom to the piston to revolve in the cylinder, allowing the surfaces of the packing-rings and cylinder to adjust and wear more smoothly, and prevent cutting, than can be obtained when the piston is rigidly fixed in the cross-head. The steam-chest and valve-motion are of the usual construction. F is the end view of carriage, with the head-blocks, G, and dogs to secure the logs while being sawed. H are racks and pinions to give the desired motion to the carriage. I are rolls under the carriage, and guides by the segments to secure a straight line for the carriage. J are pulleys so arranged in connexion with clutches, tightening-pulley, and belt, to back the carriages for either saws. K are crank fly-wheels for the engine, regulating the motion and stroke of the saws by the connecting-rods, L, secured firmly with the lower saw-buckles and crank-pin, M, thereby giving firmness to the cut of the saws by the momentum of the fly-wheel. N is the eccentric to give motion to the valve in the steam-chest (not shown). O is the eccentric to give motion to a rock-shaft for feeding the carriages forward with the logs to the saws, and readily adjusted while the saws are cutting to give any required feed to either saw. P is the pulley for pump to supply boilers in the usual way. Q is the stand and pedestal to support engine-frame, fly-wheels, and shaft. R are foundation-timbers well bolted together. S is the pulley to give motion to any machinery desirable, as circular saws to saw lath, palings, edging-boards, as well as for small portable mills for griuding grain, or any purpose, as the engine will work as efficiently without working the upright saws as any other engine of the same boiler-power.

The best site to erect this mill upon is a sloping grouud, with a wall on the side next to the high side, to keep back the ground; and excavating a foundation on the lower side, giving sufficient elevation for room to work under the mill and get out the sawdust, chips, and wastage at a convenient elevation to the mouth of the boiler-furnace, to use as fuel.

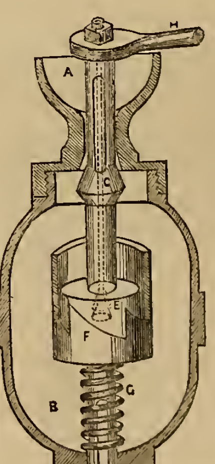
The logs on the elevated ground above the mill can be readily put on the carriages for sawing, and the lumber turned off at the lower side, thereby avoiding much labour of handling heavy lumber when the locations are not well selected.

A space ten feet square in the sawpit is sufficiently large for the machinery below; and a width of room above, say fourteen feet wide by double length of the timber desired to be sawed, and one story of eight feet high, with sufficient covering to keep out the weather, is all that is desired. The wall under and outside of the boiler-walls will answer to support the machinery. This mill will do as much work as any other with the same number of saws driven in a saw-gate. As much power may be given to the saws as will force them into the wood at each cut, as far as the saws are able to withstand the resistance against them. As regards keeping all the parts in order, this depends on the workmanship of the machine itself, and the parties using it. The principle of the construction of this mill, Mr. Brown says, renders it less liable to get out of order (it having no more than one-half the number of parts) than other steam-mills, while, at the same time, it has an important feature in the engine itself that avoids one of the greatest difficulties in sawing, viz., getting out of line and cutting the cylinder—an evil to which all other engines are liable without the greatest care.

A less number of workmen can keep it in operation, and do as much work. The engine is under the control of the sawyer, who is also the engineer, and regulates the speed to suit the work; and he alone can perform all the work of sawing after the logs are put on without stopping the mill, thereby needing ordinary hands only for handling lumber, cleaning up the sawdust and wastage into the furnace, to keep up the steam.

This mill can be completed at the machine-shop, requiring not more than ten days to put it up on its foundations, they being prepared. He is now constructing double gangs, carrying fifty saws, cutting at the same time, with rollers and feed-power, making a continuous cut at the timber, the logs following each other through the gangs, and cutting up the lumber to any dimensions with rapidity and accuracy, thereby making a most substantial machine for sawing.

IMPROVED AUGER. — Mr. Hoagland, of Jersey City, N. J., very recently patented an improvement in augers, which we think well worthy of illustrating in THE ARTIZAN. The following description, aided by the perspective view, will make the improvement apparent:—The improvement is a very simple but a very useful and important one. It consists in having the cutting portion of the auger made separate from the screw, and combining the two parts by means of a dowel and a screw in dovetail form. A is the screw portion, or *stock*, and B is the cutting portion, or *bit*, of the auger; *e* is the screw which fastens these two parts together; and *f* is a dowel which serves to prevent any play of the cutter independent of the screw, when working. More than one dowel may be used, but one is sufficient, as there is very little pressure upon it. The object of this improvement is to allow of the screw part of an auger, which endures for a very long time, to be used for any number of the cutting parts, so that the latter can be renewed when required, if broken or worn out. For ship-carpenters the invention is of great advantage. A series of stocks may be made and marked with the letters of the alphabet. To each there may be several sizes of bits marked and adapted to fit accurately, and thus the carpenter, if supplied with a proper number of auger stocks and bits, will be able, without loss of time, to bore for any size of treenail. He will thus lose no time, as he now frequently does, in searching for a new auger, or getting a broken one mended, if he should break his bit against an iron bolt. If he wishes to bore for new treenails of a different size from that which he has been using and boring for, he has but to unscrew his *bit* and put on another of a different size on the same stock, to bore a hole of a proper size. As a stock like A is for permanent use, it may be made of cast-steel aud polished; this would be too expensive for common augers. Adaptable *bits*, like this one, have also the advantage of being more easily and better tempered than those forming one piece with the stock. The improvement can be applied to various kinds of augers used for different kiuds of work. As the cutting portion of an auger stands but a limited amount of usage, and is often destroyed by coming in contact with nails and bolts in boring, the whole auger is soon rendered useless, and a new one required. All that is required to render this auger always new, is the renewal of the small and simple bit, B.



MITCHELL'S PATENT LUBRICATOR.

THIS invention, which is intended to effect economy in the lubrication of steam-cylinders and such-like purposes, is a simple and very effective apparatus. The accompanying engraving is a section, and exhibits the construction and mode of working. A is the cup, or top receiver; B is the chamber in which the lubricating material is received; C is a cone-valve upon the spindle, which valve is seated into the under side of the cup, A; D is a similar cone-valve at the bottom of the spindle, seated into the screwed nose-piece of lubricator; E is a small air-vessel, which allows of the air escaping through the centre of the upper spindle; F is a clutch-like catch-box, the top half being attached to the upper valve spindle, and the bottom half is attached to the bottom valve spindle; G is a spiral spring, which pressing the lower half of the catch-box upward, keeps the lower valve, D, closed; H is a handle for turning the top spindle; I is a stud or feather, working in a groove to prevent the valve D and its spindle from turning round. When the lubricating liquid, &c., are poured into the cup, A, it flows freely into the chamber, B, the air escaping through the valve E. When it is required to lubricate the machine to which it is attached, the handle, H, is turned rouud; the parts of the catch-box separate; the valve C first closes the upper aperture, aud then the lower valve, D, is opened by continuing to move the handle sufficiently far round; and thus the grease is directly admitted into the steam-cylinder, the pressure of the steam closing the air-valve E, and preventing any blowing out or loss of the grease.

QUEEN *v.* HANCOCK.

In the Queen's Bench.

On the 5th instant, Sir F. Thesiger, on behalf of Mr. Hancock, obtained a rule calling on the prosecutors to show cause why the writ of *scire facias* to repeal the patent of Mr. Hancock, which was for improvements in the manufacture of caoutchouc, should not be quashed, set aside, reformed, or amended by striking out the recital of the deposit paper, on the ground that it was pleading that which should form part of the evidence on the trial.

On the 7th, Mr. Hugh Hill, on behalf of the prosecutors, obtained a rule calling on the defendant to show cause why the name should not be changed from Middlesex to London, alleging that the object of the previous application was to create delay, and throw the trial over the long vacation.

On the 12th, both rules came on for argument, when, after some discussion, it was arranged by the Counsel on both sides that the pleadings should be put in such a form as best to try the real question between the parties—namely, whether, when Mr. Hancock lodged his deposit paper in 1843, he had within his knowledge the third head of the invention, which he subsequently described in his specification, and for which the letters patent were granted; or whether he afterwards became aware of it by communication from others, or otherwise. Upon this will depend the existence of the patent, as, if he claimed by his deposit paper more than he had invented at the time of his application, and so deceived the Crown in its grant, the patent will be void.

Sir F. Thesiger also consented to the change of venue from Middlesex to London; so that this important question, which has been the subject of so much litigation, and in which all engaged in the india-rubber trade are deeply interested, will be tried, in all probability, at the next sittings in London.

CORRESPONDENCE.

THE VALUE OF THE INTEREST ON MONEY.

To the Editor of The Artizan.

Sir,—The value of the interest on money is well understood and acted upon by our principal manufacturers and commercial men; though, unfortunately, it is often disregarded in minor concerns, as it uniformly is by Government, and that notwithstanding its influence on public expenditure, and on the economical productions of our manufactories and our commercial concerns. Thus, for instance, with a view to prevent the overworking of children and young persons, it has been by law established that they should be employed only at stated times, thus debarring the manufacturer from making the greatest use of his buildings and machinery, thereby causing an unnecessarily greater portion of the interest on capital sunk to be had on the goods produced. In this instance it would seem that the needed good might have been obtained of sparing children and young persons work beyond their strength, by the simple enactment of limiting the hours of their labour, and consequently permitting relays, so as to enable the manufacturer to make full use of his buildings and machinery. By this mode of working the hours allotted to children and young persons, ample time might have been given them for education, for rest, and for recreation, without loss to the master manufacturer.

It may be questioned whether relays of men and women might not also be advantageous by thus enabling the manufacturer to make better use than at present of his sunken capital. It appeared in the metal-mills in Portsmouth Dockyard, that by a continuous use of them, a saving was effected of no less a sum than £1,500 per annum.*

As to the losses sustained by the public from a disregard of the value of the interest on money in our public departments, it is immense, though unnoticed at the present day. Sir Samuel Bentham, during a period of 36 years, did his utmost to call attention to the subject in one department of Government, that of the Navy; his efforts are recorded so early as the year 1798, in his reports and evidence to the Select Committee on Finance of the House of Commons, 1798, and subsequently down to the year 1831, in various of his letters to the Admiralty. To the Committee on Finance of 1798, in consequence of his previous statement, and in answer to the question—Is there any account kept of the interest on money expended on naval works?" he replied, "None, in the dockyards, nor yet, I believe, in any of the public offices; and I conceive that great loss arises from want of attention to the subject. I mean, more especially in the case of works of lasting use, such as docks, storehouses, &c. In the case of a work of a lasting nature, it is the interest on the capital, added to an annual compensation for the sinking a capital on a work liable to have its value impaired by a variety of contingencies, that is the sum to be brought into comparison with the annual amount of the benefit expected from the work. Eight per cent. seems to be the least that can be set down under the head of annual loss; and under the head of annual profit would be set down the estimated value of the use of the work for that time."

The General went on to speak of the advantages that would result from an habitual observance of such a comparison: "It would operate," he said, "as a *check* to the undertaking works of which the annual use could not compensate for the annual expense; and it would operate as a *spur* to the speedy execution of a work." Sir Samuel elucidated this point by observing, in his evidence, that the real cost of a work depended as much on the accumulated interest during delays on the capital from time to time expended, as on the capital itself; and, therefore, "it would operate as a *memento*," he added, "to make the earliest and the greatest possible use of a work." He further stated, that many works had presented themselves to him, which, in comparison with existing ones, promised considerable utility, but which, "when brought to the test of this parallel, I have found myself impelled, as it were, to give up the thought of."

* Miscellaneous Papers, No. 8, page 16.

For a period of about nine years, Sir Samuel was charged with the duty of preparing the estimates to be laid before Parliament for naval works, during which time, in conformity to the above-cited opinions, he formed for himself the following rules:—

1st. Never to insert a work which would not, in the way of rent for its use, pay the current rate of interest on the capital expended upon it, together with a reasonable compensation for wear-and-tear, as also for the chance of its disuse.

2nd. Never to recommend the *premature* commencement of a work—that is, the commencement of it before assurance was obtained that funds would be forthcoming for carrying it on with the greatest possible expedition consistent with its economical prosecution in respect to the procurement of materials and labour.

3rd. When—as often happens in regard to public works—money for its execution can only be obtained by dribblets, so many hundreds or thousands of pounds this year, and so on—in such cases to advise delay of the commencement of the work till sufficient funds are collected for its speedy prosecution; the funds annually amassed being, in the interval, put out to interest, and thus adding to the capital itself; or, as regards public expenditure, the saving to the people so much money as that interest would amount to.

4th. To confine the works to be carried on at the same time to such a number of them as the funds raised within the year will suffice for the carrying on such works with expedition and economy.

At first sight, it may not seem to be within the province of The Artizan to descant on public works; but, on the contrary, seeing how generally the measures of Government are discussed, it appears highly desirable that they should be so on true principles. Should those on which Sir Samuel Bentham acted be otherwise than sound, doubtless some of the many correspondents of The Artizan will point out the fallacy of his opinions.

It may further be noticed that many of his observations are applicable to private undertakings, several of which have their cost enhanced by non-attention to one or other of his rules. Thus, for example, it is of frequent occurrence that the building of houses is commenced before sufficient funds are forthcoming for their completion; whereas, had the dribblets of cash at command been put out at interest, that interest would have augmented the capital itself, whilst the materials employed would not have been exposed to injury by delays of construction. So it is frequently seen that works carried on by joint-stock management are not brought into use till long after they might have been completed, so as to yield a return in the way of rent.

I am, Sir, &c. &c.,

M. S. Bentham.

THE PANOPTICON.

To the Editor of The Artizan.

Sir,—In the year 1784 the late Brigadier-General Sir Samuel Bentham, when in command of a battalion of 1,200 troops, observed that extensive manufactories of a friend were unprofitably conducted, and therefore volunteered the direction of them. Early in their management he perceived that the several overlookers neglected their duty, whilst much of his own time was consumed going from place to place to inspect them and the operatives under his control; he therefore invented a building wherein, from a central spot, all the works going on within the building could be distinctly seen. This structure his brother—the celebrated Jeremy Bentham—described, in a letter to their father, calling the invention a Panopticon, or Inspection-house, and enumerated many purposes to which it was applicable. This letter has given rise to the notion that Jeremy himself invented the Panopticon, though he distinctly and repeatedly said in that letter that the Panopticon was due to his brother Samuel.

The original design of a Panopticon was confined to a circular structure of a hundred feet in diameter, in the centre of which the inspector had a chamber, from whence the works going on around him could be distinctly seen, and by a peculiar arrangement of the windows, without exposing the inspector himself to the view of operatives, or of their overlookers. At a future period, Sir Samuel devised the addition of radial buildings to that central part, all of which rays were equally subject to inspection from the centre.

Down to the present day the Panopticon principle has never, in this country, been resorted to for any other purpose than that of prisons; but the enlightened views of our manufacturers, at this time, render it probable that the Panopticon principle will be adopted for manufactories, seeing how many overlookers may thereby be spared, and that it affords to the master an opportunity of witnessing himself all the operations carried on in his establishment, and that even without loss of his precious time, since, by the enclosure of a central office for him, he could, therefore, cast a glance over all the works going on without disarrangement of his more important business: but it needs much independent spirit to discard old habits of building quadrangles, or long lines of structures, each portion of which exacting a separate visit.

In the year 1807, Sir Samuel being then on a mission from this country to Russia, and having received instructions from Government to exert himself in conciliating the Emperor Alexander of Russia, constructed for his Imperial Majesty a Panopticon School of Arts. This building consisted of a central part, 140 feet diameter, from which five ways projected, each of them 104 feet in length, and 40 broad. This structure ascertained with certainty that Sir Samuel's plan was nowise visionary, for from the centre of the circular building was distinctly seen to the very end of the five ways projecting from it. War unhappily broke out between England and Russia before Sir Samuel could set the Panopticon to work as a School of Arts, wherein clothing and instruments for the army and navy should be made; but, under inferior management, the facility of inspection afforded by this plan was found highly conducive to good order, to the progress of the pupils, and to the production of manufactured articles at a comparatively small cost.

The experience thus obtained seems to point out the eligibility of similar structures for all manufacturing purposes, as also for schools of every description; but many years may still elapse ere architects are likely to abandon the old mode of long lines of manufacturing erections, or the arranging them on the four sides of a quadrangular space. The Panopticon principle also affords an advantage rarely attainable in any other mode of building, namely, that of enlargement of the premises without detriment to appearance. Thus, a Panopticon might at its first erection consist of no more than the central part, and that of greater or lesser diameter at pleasure; to this centre might be added a wing at a time, according as the business of the manufactory might increase, or the number of pupils in a school be augmented.

As to architectural beauty, and conformity to what is considered as established in regard to it, Sir Samuel himself devised the means of their accordance with the Panopticon principle, without prejudice to it in favour of Greek and Roman architecture. He having been requested by the late General Twiss to give the plan of a Panopticon on which to erect a school for the gentlemen cadets at Woolwich, and conceiving that no great departure would be tolerated from the ideas of beauty then as still entertained, arranged the school in such manner as that only the *half* of a duodecagon was designed, thus leaving a long line of façade to be presented as a frontage, and capable of being erected according to any style of architecture that might be preferred. According to this design, the Lieutenant-Governor's study and desk were placed in the centre of the long façade; the study was enclosed by a glass partition, commanding a view of the three classes into which the gentlemen cadets were divided; the fourth section being appropriated as a fencing school, and the whole of these schools occupying the first floor of the building: the ground floor was destined for a museum and a library. According to this design, the several masters were as much under inspection by the Lieutenant-Governor as the boys themselves. Therefore, probably, constant inspection of the masters' proceedings being thought intolerable, the plan was not carried into execution.

That plan, however, suggested the notion that some similar arrangement might suit for schools on a small scale. Accordingly, a sketch was made of the manner in which a head teacher might have under his eye all the pupils of a small school, as also all the teachers and pupil-teachers employed. This desirable purpose was proposed to be effected by placing the head teacher against the longest side of the school-room, and in the middle of it, his or her own class being seated in front of the teacher, and closed in, where the cost could be afforded, by a glass partition; the less advanced pupils placed radially in the remaining and larger portion of the room: the several classes were proposed to be separated from each other by curtains, any or all of them easily drawn away on the occasion of a lecture or other way of giving general instruction. The pupils' seats were designed to be raised, gallery fashion, one above the other towards the wall opposite to the head teacher, whereby all the scholars would be placed under inspection. This project was favoured with a place in the Educational Exhibition of 1854, and still remains at the disposal of Government, a permanent educational exhibition having been accorded at the solicitation of the Society of Arts, Manufactures, and Commerce. It seems superfluous to observe that in small schools the under-teachers have frequently no less need of supervision than the pupils; and that where curtains are employed, the several classes are wholly concealed from the view of the head teacher, excepting only his own class.

So far, every school-room is susceptible of being arranged on the inspection principle; but, on the construction of a new edifice for a school, architects need not be told that a circular building is the cheapest of any form that can be given it, as a circle encloses the greatest area in proportion to length of wall. It is true, indeed, that bricks suitable for a circular building have not yet been moulded, and that timber is generally straight; circumstances that induced Sir Samuel Bentham to make the Ochte Panopticon a duodecagon, and which point out some pentagon as the shape best adapted for a structure on that principle; that is, supposing the pentagon decided on to include a large space in proportion to wall.

At this period of extraordinary advancement in most arts and sciences, it seems remarkable that architecture should still be based on ancient models. Although iron be now so extensively used, this material has not given rise to any new order of architecture; but, on the contrary, iron is made to assume the appearance of stone. One bold exception to established rule was, however, made in the Crystal Palace in Hyde Park, as also in its prototype at Sydenham; otherwise we continue but mere copyists; and as emancipation from old practice has been successful in crystal palaces, it may be at length hoped that Panopticon buildings will be introduced for all the many services to which they are peculiarly applicable.

I am, Sir, &c. &c.,
M. S. Bentham.

ROYAL SCOTTISH SOCIETY OF ARTS.

1. *Description and Drawing of a Self-acting Feed and Brine Apparatus for Marine Boilers.*—Sea-water contains salt in the proportion of 1 to 32. To get rid of this salt, which crystallises very rapidly in the marine boiler, many plans have been adopted. It was an early and long-standing practice to blow off large *indefinite* quantities every four hours. It was then found more economical to pump out by pumps, worked by the steam-engine, a given *proportion* of surcharged or *brine* water. This self-acting feed and brine apparatus is designed to discharge the brine by means of the pressure in the boiler, a *proportionate* quantity, say 2·7 brine to 9·6 feed. The brine value is in connexion with the feed value: the latter is acted on by the engine, and is opened or shut more or less in proportion as the engines are going slow or fast, or suddenly stopped. The principle on which it is designed is, that the outgoing brine is always in proportion to the incoming feed, however much that may vary.—Thanks voted.

2. *Description and Drawing of the Condensers used in the Royal Navy for distilling Fresh Water.*—To convert salt water into *fresh* on board ship at sea has long been a desideratum. A French steam cooking galley, constructed so that the fuel expended in cooking should also be used in distilling fresh water, was a few years ago so altered and improved by Mr. Grant, of the Royal Clarence Victualling Yard, that Grant's galleys were coming into general use in the Royal Navy. It was afterwards proposed to fix a condenser on board all steam screw-ships, and to connect these condensers with the boilers of the steam-engines. The condensers are placed under the water-line of the ship, when the sea-water is, by a simple arrangement of pipes, allowed to flow round the outsides of a series of small tubes through which the steam is passed, condensed, and run into the tank-hold of the ship without any manual labour being required in the operation. The proportions of condensing surface in the tubes are, for every 100 men, where one condenser only is used, twenty square feet; where two are used, sixteen square feet. The quantity made per hour, about 150 gallons, or three tons.—Thanks voted.

3. *Description of a Plan of Stereotype Moulding for Casting Brass Nails, &c., as practised at Portsmouth Dockyard.*—A model was exhibited. This is a contrivance by which the old system of moulding even the smallest article (by taking out of the sand and manipulating every separate pattern, and where skilled labour is used) is superseded. By this plan of a fixed pattern on a plate carefully fitted up, any number of castings can be produced from the same pattern; by which plan skilled labour is entirely superseded, the production of small articles especially indefinitely increased, and the quality of the articles produced materially improved.

NOTES AND NOVELTIES.

New Steam Fuel.—We have recently been shown some specimens of steam-fuel made into large blocks from the small of anthracite coal, by a new process recently patented. For density we do not remember to have seen any specimens equal to the present fuel; and it has this peculiarity, that when thrown into the furnace it gradually increases in size, whilst it burns away gradually with a good flame. It does not clinker; nor, with a moderate draught, does it leave any ash.

Some blocks of 12 × 12 × 4⅝ inches, weighing 26 lbs., made from the small of Fothergill's Aberdare steam-coal, were tried, against the large of the coals from which the smalls were screened, under a 15-horse high-pressure cylindrical boiler; and, without proposing to exhibit accurately the qualities of the patent fuel by the usual test of the comparative evaporating powers of the two fuels, the engine-driver reports that he consumed 10 cwt. of the larger Aberdare coals in six hours, maintaining 25 lbs. pressure; but with the patent fuel from Aberdare small coal, he kept 30 lbs. of steam freely, and only consumed 6½ cwt. in six hours.

New Screw War Steamers.—We are glad to hear that the Sardinian Government have ordered, in the North, two screw-steamers of the *Carlo Alberto* class, of 400-horse power, and mounting 51 guns; the performances of that vessel having given great satisfaction, and such as are highly creditable to the engineers and builders.

Reform of the War Department.—We are pleased to find that the War Department is undergoing a thorough reform, and that amongst the recent improvements introduced is the appointment of Civil Surveyors, to form a complete topographical staff in connexion with this department of the public service; and we look forward with some anxiety to the efficient working of this corps, and hope for its success. It is an admirable contrivance, but must not be clogged and hampered by military routine and mismanagement.

Great Transatlantic Telegraph.—We understand that there is at least a reasonable hope that, within two years, we shall be enabled to telegraph direct to our Transatlantic friends; and we are told that, for this purpose, negotiations have been concluded with the inventor of the very ingenious method for making and laying down submarine cables at sea, which was exhibited at the President's Conversazione at the Institution of Civil Engineers the other evening, and which attracted considerable attention. The route projected by Mr. William Smith, C.E., has been thought the most desirable one in a commercial point of view, and it has received the approval of the highest authorities upon Atlantic and telegraphic matters.

We hope shortly to be able to give a plate of Mr. W. Smith's great Atlantic telegraph cable-making machinery, and also a chart of the proposed Transatlantic lines.

The Swiss Drawing Instruments.—We were much pleased the other evening, at the Institution of Civil Engineers, at having the opportunity of examining these instruments, and were agreeably surprised to find the workmanship so excellent, and the prices so moderate; and when we remember the price we paid for our last case, that the instruments are not superior in make, and we doubt if they are equal to the best Swiss instruments exhibited, we candidly confess that we shall not in future indulge in such extravagance, nor advise our friends to do so.

We have since examined these instruments more carefully, having taken the joints, screws, &c., apart; and we find the joints very accurate, the threads of the screws true, the springs well tempered, and the points very hard and carefully finished.

Prejudice may have operated against their introduction amongst engineers, but we feel assured that it must yield upon examination of the instruments, and comparing them and their prices with similar instruments sold by London shopkeepers.

NOTICES TO CORRESPONDENTS.

Q.—The Chart of Gales and Fogs which should have accompanied the paper by Lieut. Maury, U.S.N., printed in our last number, is given this month. You will now be able to understand the subject, if you re-peruse the paper, referring at the same time to the Chart.

R. S.—We give, in the present number, a few American inventions recently patented. These are not to be accepted as samples of the general character of inventions patented in the United States: the subjects given in the present number are above the general standard of merit.

A.—Not so. *We* only notice matters which *we* think possess sufficient merit to deserve a space in our columns, and are of practical use to our readers. We cannot comply with your request; we are inundated with such stupidities. *New motive powers* of the order Perpetual Motion are not in favour.

J. CAMERON.—We regret that your letter was mislaid, and has but just turned up. We will reply fully to your inquiries, by post, within a week.

A SUBSCRIBER.—Guest, Thetford. If you will forward your address, we will answer your inquiry about the Kuhoukorf coil apparatus by post.

G. and R. A.—We have not seen any third edition of the book alluded to, so cannot give you the information. It is no doubt by Mr. Main, of the Royal Naval College. We hope to be able to give you the information by next month.

MERCURY.—Your inquiry is answered elsewhere in our columns. Our advice is "*Do so no more.*" Remember, it is said, prevention is better than cure.

Books for Review, &c., must be sent early in the month.

The concluding parts of the articles on Steam Colliers, the Mal-Administration of the Patent Law, &c., as also the papers on Steam Coal Hoists—Remarks on Armstrong's Patent Hydraulic Lift—Notes on the Exhibitions of the Society of Arts, 1855—the Crystal Palace, with the arrangement of its Hydraulic Works, &c., and various other matters, must stand over until next month.

The second notice of Captain Baird Smith's Italian Irrigation—the concluding notice of Dr. Hyde Clarke's Dictionary—Colonel A. Cotton's Public Works in India, 2nd edition—Rawson's Arithmetic for Artizans—Tomlinson's Illustrations of the Useful Arts—C. Hoare's Treatise on the Engineer's Slide Rule, and several other works, must remain unnoticed this month for want of space.

DIMENSIONS OF NEW STEAMERS OR SAILING VESSELS.

MELBOURNE AND LAUNCESTON NEW IRON SCREW-PROPELLER STEAM-VESSEL "ROYAL SHEPHERD."

Built and fitted with machinery by Messrs. Blackwood and Gordon, iron shipbuilders and engineers, Paisley, 1853.

Dimensions—Customs' measurement.		ft.	tenths.
Length on deck	...	148	1
Breadth at two-fifths of midship depth	...	19	8
Depth of hold amidships	...	10	5
Length of poop	...	36	6
Breadth of ditto	...	16	7
Depth of ditto	...	6	5
Length of engine-room	...	31	9
Tonnage.		Tons.	
Hull	...	$221\frac{23}{100}$	
Poop	...	$44\frac{07}{100}$	
Total	...	$265\frac{30}{100}$	
Engine-room	$71\frac{07}{100}$	$80\frac{82}{100}$	
Shaft-tunnel	$9\frac{75}{100}$		
Register	...	$184\frac{48}{100}$	
Builders' measurement		ft.	in.
Length of keel and fore-rake	...	140	0
Breadth of beam	...	20	0
Length of engine-room	...	31	11
Tonnage.		Tons.	
Hull	...	$272\frac{32}{94}$	
Engine-room	...	$67\frac{82}{94}$	
Register	...	$204\frac{44}{94}$	

A pair of oscillating engines of 50-horse nominal power: diameter of cylinder, 30 inches; length of stroke, 2 feet 6 inches. Screw-propeller: diameter, 7 feet 2 inches; pitch, 10 feet 6 inches; has two blades. One tubular boiler: length, 10 feet 4 inches; breadth, 9 feet 2 inches; depth, 10 feet 6 inches. Three furnaces. 200 tubes: diameter, $3\frac{1}{8}$ inches; length, 6 feet 6 inches. Launched November, 1853: draft of water, forward, 4 feet; ditto aft, 5 feet 7 inches: average speed, 10 knots an hour; consumes 7 cwt. of coals per hour; engines averaging 45 revolutions per minute Has passenger accommodation in full poop. Sailed out to Melbourne, from the Clyde, under canvass, and is now plying in consort with the *Black Swan*, also built by the same firm, between Launceston and Melbourne, with goods, passengers, &c.; carries about 276 tons of cargo.

DESCRIPTION.

Three masts; barque-rigged.

LIVERPOOL, BANGOR, BEAUMARIS, AND MENAI-BRIDGE NEW IRON PADDLE-WHEEL STEAM-VESSEL "ANGLESEA."

Built and fitted with machinery by Messrs. Blackwood and Jordan, iron shipbuilders and engineers, Paisley, 1855.

Builders' measurement.	ft.	in.
Length of keel and fore-rake	160	6
Breadth of beam	19	0
Length of engine-room	46	7
Tonnage.	Tons.	
Hull	$289\frac{29}{94}$	
Engine-room	$90\frac{21}{94}$	
Register	$199\frac{8}{94}$	
Customs' measurement	ft.	tenths.
Length on deck	160	6
Breadth at two-fifths of midship depth	18	6
Depth of hold amidships	10	3
Length of engine-room	46	6
Tonnage.	Tons.	
Hull	$245\frac{29}{100}$	
Engine-room	$96\frac{61}{100}$	
Register	$148\frac{68}{100}$	

One steeple-engine (one piston-rod), of 60-horse nominal power: diameter of cylinder, 42 inches; length of stroke, 4 feet. Paddle-wheels: diameter over floats, 16 feet 6 inches. 17 floats: length, 7 feet 6 inches; breadth, 1 foot 4 inches. Two tubular boilers: length at crown, 10 feet $9\frac{1}{2}$ inches; ditto at furnaces, 9 feet 11 inches; breadth, 10 feet 9 inches; depth, 9 feet. 560 cubic feet of steam and 794 cubic feet of water, when tubes are covered 9 inches. Six furnaces: length of fire-bars, 6 feet 2 inches; breadth, 2 feet 9 inches. Three furnaces in each boiler. 420 tubes, or 210 in each boiler: diameter, $3\frac{1}{8}$ inches; length, 6 feet 6 inches; having two funnels (bell-tops); diameter, 2 feet 10 inches; length, 21 feet. One boiler before and the other abaft the engine. Contents of coal-bunkers, 35 tons; frames, 3 × $2\frac{1}{2}$ × $\frac{3}{8}$ and $\frac{5}{16}$ of an inch, spaced 18 inches apart; eight strakes of plates from keel to gunwale, tapering in thickness from $\frac{7}{16}$ to $\frac{5}{16}$ of an inch; three bulk-heads. Averages 30 revolutions per minute. Was launched from the building-yard at Cartvale, March 20th. Draught of water with machinery, &c.: forward, 5 feet 8 inches; aft, 6 feet 6 inches. The cabins are very tastefully fitted up, and ornamented with stained glass paintings, representing Welsh scenery, &c. The skylight is also ornamented with stained glass, and has a handsome and beautiful appearance. The figure-head is a Welsh female, in the national costume of the country. This vessel is capable of accommodating from 350 to 400 day-passengers. The masts are rakish, with wire rigging, giving the vessel a smart-looking appearance.

DESCRIPTION.

A demi-female figure-head; no galleries; three masts; schooner-rigged; standing bowsprit; one main and quarter deck; square-sterned and clincher-built vessel; clipper-bow. Owners, Messrs. Price and Case. Port of Liverpool. Commander, Mr. John Hunter (late of the *Menai*).

NEW IRON SCREW-PROPELLER STEAM-VESSEL "CORIO."

Built by Messrs. Scott and Co., iron shipbuilders, Cartsdyke, Greenock; machinery by Messrs. Blackwood and Gordon, engineers, Paisley, 1854.

Dimensions.		ft.	tenths.
Length on deck	...	99	7
Breadth at two-fifths of midship depth	...	17	1
Depth of hold amidships	...	9	3
Length of quarter-deck	...	25	4
Breadth of ditto	...	15	0
Depth of ditto	...	2	7
Length of engine-space	...	22	8
Ditto of shaft-tunnel	...	10	4
Breadth of ditto	...	3	3
Depth of ditto	...	3	6
Tonnage.		Tons.	
Hull	...	$112\frac{70}{100}$	
Quarter-deck	...	$11\frac{13}{100}$	
Total	...	$123\frac{83}{100}$	
Engine-space	$39\frac{24}{100}$	$40\frac{55}{100}$	
Shaft-tunnel	$1\frac{31}{100}$		
Register	...	$83\frac{28}{100}$	

A pair of inverted cylinder-engines of 20-horse nominal power: diameter of cylinders, 20 inches; length of stroke, 1 foot 8 inches. Screw-propeller: diameter, 6 feet 10 inches; pitch at centre, 12 feet $10\frac{1}{2}$ inches; ditto at circumference, 14 feet 6 inches; has two blades. One tubular boiler: length at crown, 10 feet 2 inches; ditto at furnaces, 9 feet 7 inches; breadth, 6 feet 1 inch; depth, 8 feet 11 inches. No steam-chest. Two furnaces: length, 6 feet 2 inches; breadth, 2 feet 2 inches. 86 tubes: diameter, 3 inches; length, 6 feet 6 inches. Chimney (bell-top): diameter, 2 feet 7 inches; length, 20 feet 6 inches. Geelong, November 20th, arrived from the Clyde; was totally dismasted, and received other damage, in a gale which lasted from the 19th to the 29th of October (during which time, the late Commander, as also the steward, was washed overboard and lost). Employed in the coasting-trade of Australia; carries about 111 tons of cargo.

DESCRIPTION.

No figure-head or galleries; standing bowsprit; 2 masts; brig-rigged, round-sterned, and clinch-built vessel; common bow.

Port of Greenock.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 21st February, 1855.

379. J. Telle, Paris—Railways for cities and towns.

Dated 13th March, 1855.

557. E. Bourseret, Paris—Bolts, rivets, &c.

Dated 22nd March, 1855.

635. J. Snowden, Dartford—Furnaces and fireplaces.

Dated 26th March, 1855.

667. H. C. Hill, Parker-street, Kingsland—Waterproof flocked cloth and other fabrics.

Dated 3rd April, 1855.

745. L. Cornides, 4, Trafalgar-square—Rendering leather, paper, and textile fabrics impervious to water.

Dated 13th April, 1855.

817. W. Weallens, and G. A. Crow, Newcastle-on-Tyne—Marine engines.

Dated 19th April, 1855.

865. T. Jackson, Commercial-road, Pimlico—Railway signals.

869. C. M. Congreve, New York—Iron. (A communication.)

Dated 12th May, 1855.

1073. J. Beckett, Preston—Spinning machinery.

Dated 15th May, 1855.

1097. R. Jobson, Dudley, and J. Jobson, Derby—Moulds for casting metals.

1099. G. T. Bousfield, 8, Sussex-place, Brixton—Wrought nails.

Dated 16th May, 1855.

1100. G. Saxon, Openshaw—Safety-plugs for boilers and valves.
1102. T. Richardson, Leeds—Dyeing cloth.
1103. A. R. le Mire de Normandy, 67, Judd-street—Oily acids and soap.
1104. E. P. Plenty and W. Pain, Newbury—Ploughs.
1105. C. W. Siemens, John-st., Adelphi—Freezing water, &c.
1107. R. Jamieson, Ashton-under-Lyne—Forging-machine.
1108. R. and E. Vezey, Bath—Carriage steps.
1109. J. H. Porter, Birmingham—Coupling blocks for roof trusses.
1111. R. Murdoch, Glasgow—Sowing seeds and depositing manure.
1112. W. Rye, Miles Platting—Railway wheel.

Dated 17th May, 1855.

1113. T. Dawson, King's Arms-yard—Cases for pen, ink, and stamps.
1114. A. M. Mennet, Paris—Ornamenting fabrics.
1115. J. G. Butt and J. H. Martin, Paris—Rotary engines.
1116. W. Johnson, 47, Lincoln's-inn-fields—Oily, resinous, and gummy substances and soaps. (A communication.)
1117. F. D. Blyth, Birmingham—Tea-trays, picture-frames, &c.
1118. J. Rae, Alpha-road, New-cross—Warming railway carriages, &c.

Dated 18th May, 1855.

1120. B. T. Warée, Paris—Sharpening pencils.
1121. C. C. E. Minié, Paris—Breech-loading fire-arms.
1122. J. Jeffreys, Kingston—Sun-blinds.
1123. E. Morewood and G. Rogers, Enfield—Coating wrought-iron.
1124. J. Cumming, Glasgow—Looms.
1125. W. H. D. Granville, Stokenchurch, Oxford—Fire-arms and cartridges.

Dated 21st May, 1855.

1126. R. J. Stainton and E. C. Davey, 14, Holland-street, Blackfriars—Warming-stoves.
1127. W. H. Tucker, Fleet-street—Locks.
1128. P. B. Eassie, Gloucester—Elliptograph.
1129. H. H. Watson, Little Bolton, and J. Oliver, Over Hulton—Fuel.
1130. B. Nicholls, East-street, Old Kent-road—Buttons.
1131. P. F. Didot, Paris—Bleaching paper pulp, &c.
1132. S. Stocker, Brighton—Shaping machinery.
1133. F. W. Mowbray, Shipley, near Leeds—Looms.
1134. T. Piggott, Birmingham—Telescopic gas-holders.
1135. E. H. Bennett, Birmingham—Roasting-jacks.
1136. W. J. Curtis, Hardinge-street, Islington—Aëronautics.
1137. H. Whitaker, Buffalo, New York — Propulsion of steam-vessels.
1138. L. F. J. Ravenstin and C. Chatel, Paris—Blinds, screens, &c.
1139. I. J. Silbermann, jun., Paris—Printing.
1140. A. F. Cossus, Cagliari—Treating oils, &c.
1141. W. Longmaid, Victoria-cottage, Stoke Newington, and J. Longbottom, Leeds—Heating coppers, pans, and boilers.
1142. J. L. Rey and A. Guibert, Marseilles—Submarine and preserving coating.
1143. T. G. Shaw, Old Broad-street—Conductor for decanting wine, &c.
1144. A. H. Mentha, Manchester—Wadding.
1145. W. Mac Naught, Manchester—Steam-boilers.
1146. J. M. Murton, 3, Somers-place west—Sister-hooks and thimbles for ships' and boats' riggings.
1147. J. Shanks, Arbroath—Mowing-machines.
1148. J. H. Johnson, 47, Lincoln's-inn-fields—Signals for nautical purposes. (A communication.)
1149. J. H. Johnson, 47, Lincoln's-inn-fields—Vulcanising and rendering hard india-rubber and gutta-percha, and application of to parts of machinery, &c. (A communication.)
1150. A. V. Newton, 66, Chancery-lane—Watches. (A communication.)

Dated 22nd May, 1855.

1151. H. E. Scott, Brixton—Ships.
1152. J. Cruickshank, Marcassie, N.B.—Cavalry equipment.
1153. G. Collier, Halifax—Looms.
1154. H. Holland, Westfield, U.S.—Treating metalliferous sulphurets.
1155. T. Holt and J. Sagar, Blackburn—Looms.
1156. J. Morgan, Manchester—Platted wicks for candles.

Dated 23rd May, 1855.

1157. J. J. Meyer, Rochdale—Shaping wood.
1159. J. Eden, Lytham—Drying fabrics.
1160. F. Leeshing, Busby, near Glasgow — Preparing dye-stuffs.
1161. D. L. Davis, Dedham, Massachusetts—Elastic bearings for chairs and rails.
1162. T. McLow, 6, Middle-row, Holborn—Paddle-wheels.
1163. A. V. Newton, 66, Chancery-lane—Beehives. (A communication.)
1164. W. Smith, 10, Salisbury-street, Adelphi — Safety apparatus for mine-shafts. (A communication.)
1165. W. Smith, 10, Salisbury-street, Adelphi—Safety apparatus for steam-boilers. (A communication.)

Dated 24th May, 1855.

1166. W. Smith, Snow-hill, and N. F. Taylor, Gloucester-terrace, Chelsea—Gas-meters.
1167. J. A. Longridge, Newcastle-on-Tyne—Artillery.
1168. A. F. G. Seegers, Paris—Paper-hangings.
1169. J. Mitchell and J. Entwisle, Bury—Presser flyers for roving-frames.
1170. J. Park, Bury—Paper pulp.
1171. J. Hudson, Laurel-place, Dalston, and G. R. Williams, Stanley-street, Chelsea—Water-meters.
1172. C. Rawlings, Sherborne—Writing-desks.
1173. G. W. Muir, Glasgow, and M. Gray, Bonhill, N.B.—Admitting air to furnaces.
1176. O. R. Chase, Boston, U.S.—Machine for making confectioners' "pipe," &c.
1178. T. McLow, 6, Middle-row, Holborn—Paddle-wheels.
1179. J. Addenbrooke, Bartlett's-passage — Machinery for folding envelopes.
1180. G. Horrocks, Pilkington—Shuttles.

Dated 25th May, 1855.

1181. E. Haseler, Wolverhampton—Picture-frames.
1182. T. M. Greenhow, Newcastle—Iron-ships.
1183. A. Melville, 50, Baker-street, Portman-square — Breech-loading fire-arms and projectiles.
1184. L. de Pariente, Schaerbeck, next Brussels—Sawing wood. (A communication.)
1185. J. H. Poullain, Paris—Penholder.
1186. E. Aldridge, Boston—Water-meters, &c.
1187. H. H. Henson, Parliament-street—Goods wrappers.
1188. J. and W. Allen, Newcastle—Alkaline salts.
1189. A.P. Jaccard, Ste. Croix, Switzerland—Centre seconds movement for watches. (A communication.)

Dated 26th May, 1855.

1190. R. W. Waithman, Bentham-house, York, and J. Waithman, Manchester—Lint.
1191. F. H. Maberly, Stowmarket—Fire-arms.
1192. J. L. Lorand, 11, William-street, Hampstead-road—Railway-break.
1193. T. Mather, Preston—Pistons.
1194. R. Maclaren, Glasgow—Prevention of smoke.
1196. J. Aspinall, Fenchurch-street—Extracting moisture from various substances.
1197. A. J. H. Parent, Paris—Buttons, nails, and metallic and plastic articles.
1199. C. W. Harrison, Woolwich—Metal ropes, cables, and rods.
1200. A. E. L. Bellford, 32, Essex-street, Strand — Envelope machinery. (A communication.)
1201. A. E. L. Bellford, 32, Essex-street, Strand—Steam-engine regulator. (A communication.)
1202. T. M. Rabatte and J. Rettig, Paris—Bruising, graining, or currying leather, skins, or hides.
1203. J. Avery, 32, Essex-street, Strand — Conveying heavy weights for bridge building, &c. (A communication.)
1204. D. Methven, 9, Pembroke-cottages, Caledonian-road—Stoppers for bottles.
1205. G. Neuffer, 39, Finsbury-square—Producing patterns upon floor-cloths and other ornamental coverings.
1206. F. T. Botta, Paris—Mixed furnaces.
1207. T. Waterhouse, Sheffield — Actuating forge-hammers and pile-driving. (A communication.)
1208. A. E. L. Bellford, 32, Essex-street, Strand—Flax machinery. (A communication.)

Dated 28th May, 1855.

1209. J. B. Howell, Sheffield — Consuming gaseous products in combustion of fuel.
1210. S. Rowlands, Birmingham—Purifying gas. (A communication.)
1211. B. Fullwood, 6, Kirby-street, East India-road—Purification of mineral, vegetable, and animal matters containing oily, bituminous, &c., qualities.
1213. J. Morrison, 10, Arlington-square, New North-road—Railways.
1215. E. M. Roch, Paris — Reading or bringing into sight advertisement bills, &c.
1216. F. de Moriès, Montmartre, near Paris — Obtaining motive power.
1217. A. E. L. Bellford, 32, Essex-street, Strand—Sewing-machines. (A communication.)
1219. J. Whitehead, jun., and R. K. Whitehead, Elton, near Bury—Finishing woven fabrics.
1220. T. P. Salt, Birmingham—Artificial legs.
1221. H. Grafton, Rolls-buildings, Fetter-lane—Heating and cooking apparatus.
1222. A. Coleman, Chelmsford—Land rollers and scarifiers.

Dated 29th May, 1855.

1223. D. Dunn, 9, King's-road, Pentonville—Steam-boilers.
1224. J. B. Acklin, Paris—Substituting paper for pasteboard in Jacquard looms.
1225. E. J. Lafond and Count L. A. de Chantauvillard, Belleville, near Paris — Obtaining oils, essences, paraffine, &c.
1226. E. J. Payne, Birmingham—Covered thread. (A communication.)
1227. E. Clowes, King's Bench-walk, Temple—Spring. (A communication.)
1228. W. Langshaw, Eagley, near Bolton, and G. and W. Jelley, Leicester — Fancy fabrics with both sides alike.
1229. T. V. Lee, Dulwich—Generating steam.
1230. G. Rogers, Alfred-place west, Thurloe-square—Apparatus for aërated liquors. (A communication.)
1231. W. A. Henry, Sheffield—Vices.
1232. J. H. Johnson, 47, Lincoln's-inn-fields—Casting metals. (A communication.)
1233. J. H. Johnson, 47, Lincoln's-inn-fields—Stamping and embossing presses. (A communication.)
1234. T. McLow, 6, Middle-row, Holborn—Screw-propellers.

Dated 30th May, 1855.

1235. R. D. Aked, 28, Matilda-street, Caledonian-road — Stands for crotchet-reels.
1236. A. V. Newton, 66, Chancery-lane—Calculating apparatus. (A communication.)

Dated 31st May, 1855.

1237. E. Wharton, Birmingham—Ordnance and fire-arms.
1238. E. Wharton, Birmingham—Metal tubes.
1239. E. Wharton, Birmingham—Steam-engines.
1240. J. L. Jullion, Tovil—Paper, &c.
1241. J. Leetch, Westminster—Helmet.
1242. W. Rimington, jun., Craven, Yorkshire—Spring hinge for swing doors.
1243. C. T. Dunlop, Glasgow—Chlorine.
1244. Sir J. W. Lubbock, Bart., Mansion-house-street—Telescopes, &c.
1245. H. Sachs, Newgate-street—Fountain pen.
1246. S. Bickerton, Oldham—Oil lubricator.
1247. Baron Espiard de Cologne, Paris—Diving apparatus.
1248. R. Ashworth and S. Stott, Rochdale — Spinning machinery.
1249. T. Worsdell, Birmingham—Lifting jacks.
1250. R. A. Brooman, 166, Fleet-street — Dyeing cotton, threads, yarns, and twists. (A communication.)

Dated 1st June, 1855.

1251. A. Jackson and E. Kershaw, Manchester, and J. Roberts, Failsworth, near Manchester—Looms.
1252. P. A. le Comte de Fontaine Moreau, Paris—Oils. (A communication.)
1253. R. Peyton, Birmingham, and A. S. Stocker, Poultry—Bedsteads.
1254. C. J. C. Venant, Amiens—Roasting coffee.
1255. J. C. Pellenz, Aix-la-Chapelle—Iron wheels.
1256. R. Whytock, Edinburgh—Colouring yarns.
1257. H. Spencer, Rochdale—Twisting and winding spun yarns.

Dated 2nd June, 1855.

1258. J. Boyd, Ashbocking—Letter-press printing machines.
1259. J. Lane, Liverpool, and J. Taylor, Birkenhead—Engine.
1260. T. Taylor and W. Smith, Manchester—Railway chairs.
1261. C. Coe, Manchester—Druggets, pilot-cloths, blankets, &c. (A communication.)
1262. C. Little, Derby—Envelope machinery.
1263. H. Cartwright, Dean, Broseley—Steam-cock.
1264. F. C. Armelin, jun., Dragnignan—Ploughs.
1266. J. T. Dore, Southampton—Needle and button cases.

Dated 4th June, 1855.

1268. P. A. Godefroy, 3, King's Mead-cottages, New North-road—Gutta-percha.
1272. W. Eley, 38, Broad-street, Golden-square—Caps for fire-arms.

Dated 5th June, 1855.

1278. J. Gedge, 4, Wellington-street south, Strand—Securing contents of bottles. (A communication.)
1280. D. N. B. Coffin, jun., Massachusetts—Stop-cocks.
1282. C. Curtice, Massachusetts—Burglar annunciator. (A communication.)
1284. E. Allen, Massachusetts—Breech-loading fire-arms.
1286. W. E. Newton, 66, Chancery-lane—Rolling bar-iron. (A communication.)

Dated 6th June, 1855.

1288. J. Gedge, 4, Wellington-street south, Strand—Preserving grain. (A communication.)
1290. J. Fielding and W. Hopwood, Blackburn—Looms.
1292. G. Hooper, Houghton-le-Spring—Rolling and shaping metals.
1294. J. Robertson, Ardrossan—Transmitting motive power.
1296. J. Boucher, 3, Surrey-villas, Camberwell New-road—Powder-flasks, and sights and ramrods.

Dated 7th June, 1855.

1300. J. Buncle, Springfield, Linlithgow—Bleaching resinous substances (calophane) for the manufacture of soap.
1302. T. Ogden, Manchester—Spinning machinery.
1304. J. A. Reynolds, Elmira, New York—Machinery for discharging volleys of shot.
1306. C. C. J. Guffroy, Lille—Smoke-consuming apparatus.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1106. R. Peters, 89, Union-street, Borough—Steam-engines.—16th May, 1855.
1174. S. S. Putnam, Massachusetts—Forging-machine.
1175. S. E. Robbins, Vermont, U.S.—Fire-arms. (Partly a communication.)—24th May, 1855.
1177. Baron von Gilgenheinch, Widenau, Silesia—Machine for tilling land.—24th May, 1855.
1214. A. E. L. Bellford, 32, Essex-street, Strand—Ordnance and cartridges. (A communication.)—28th May, 1855.

DESIGNS FOR ARTICLES OF UTILITY.

1855.

May 25. 3722. John Wright, Chipping Ongar, Essex, "A tap-protector."

,, 29. 3723. Smith, Sissous, and Co., 8, Duke-street, Adelphi, and Eyre-street, Sheffield, "Heater and part of a kettle or other vessel."

,, 31. 3724. Rowland Brotherhood, Railway Works, Chippenham, Wiltshire, "Improved capstan for turning down screw cylinders or piles."

June 1. 3725. Charles Tilston Bright, Exchange-buildings, Liverpool, "Parallel compass."

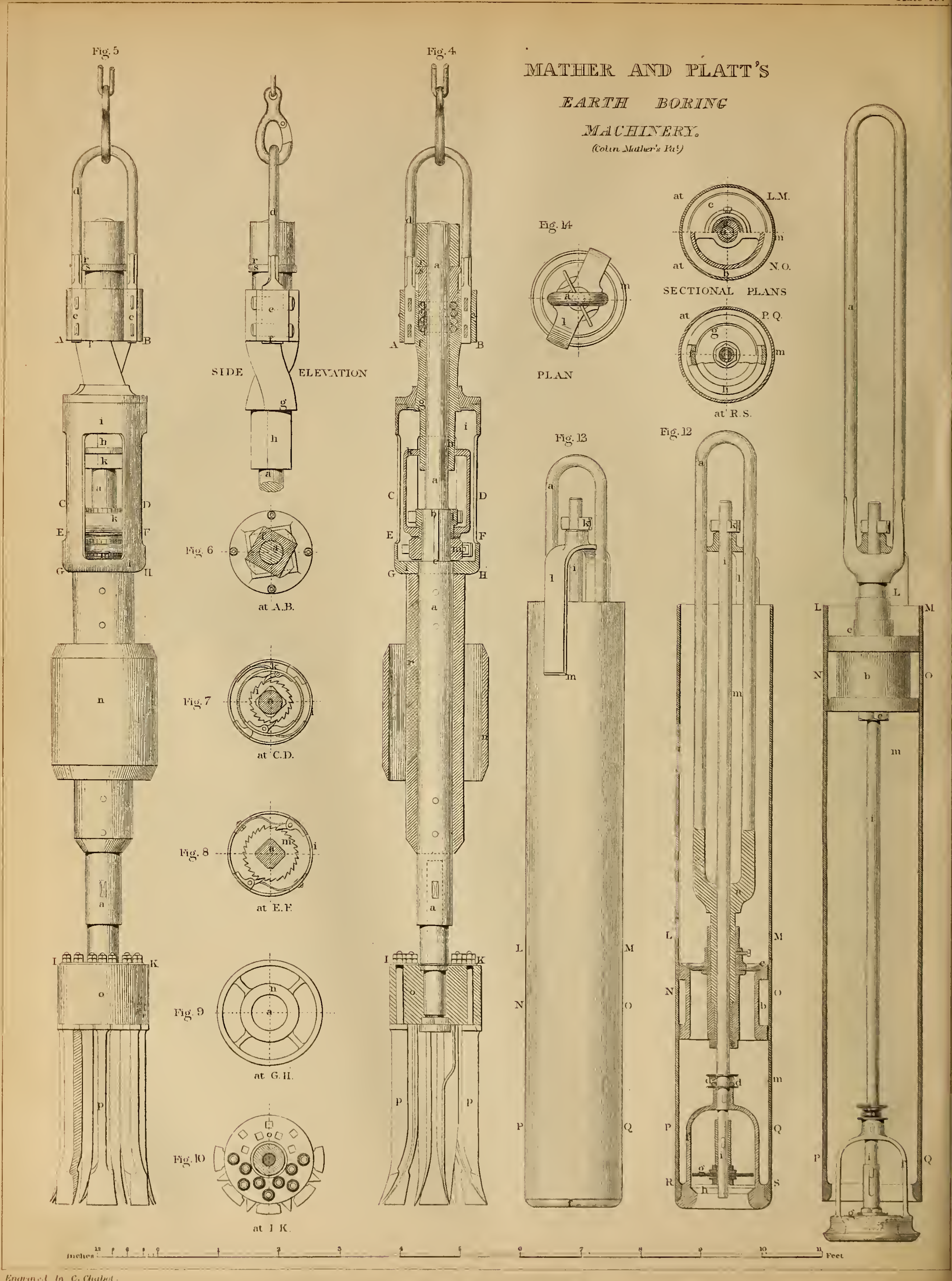
,, 6. 3726. John Cuxon, Shiffnal, Shropshire, and Charles Frederick Lucas, 8, Duke-street, St. James's, "Family fire-escape."

,, 9. 3727. Edmund Cobbett, 34, Villiers-street, Strand, "Portable camp cooking apparatus."

,, 13. 3728. Peel, Williams, and Peel, Manchester, "A compound valve for hydraulic presses and other purposes."

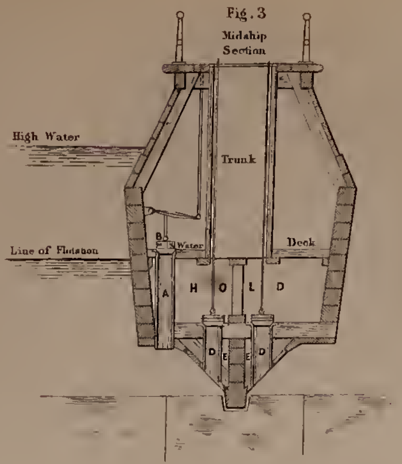
,, 18. 3729. John Hill, 212, Piccadilly, "The allied army tent."

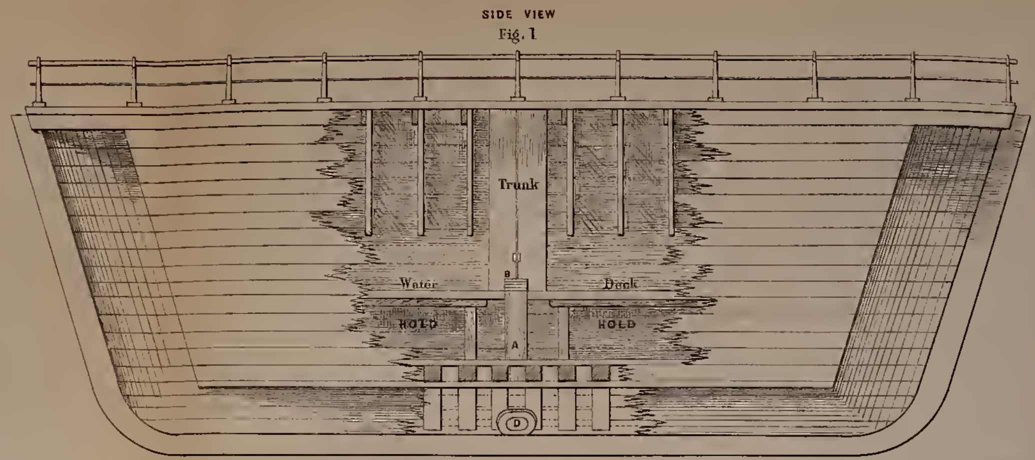
,, 19. 3730. Charles Burton, 162, Regent-street, "A sun-shade, or parasol."

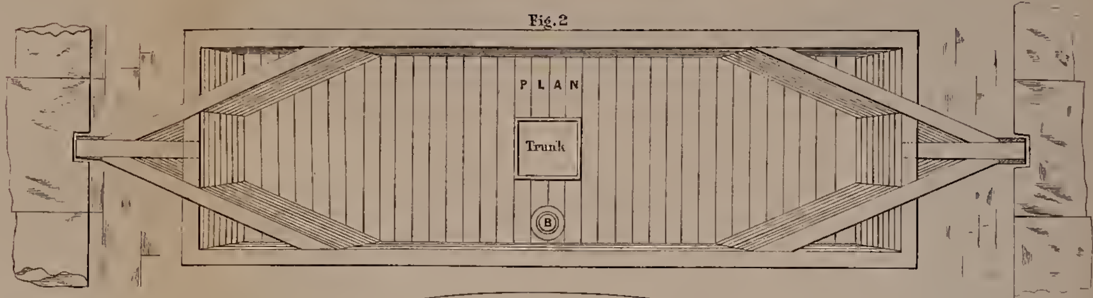


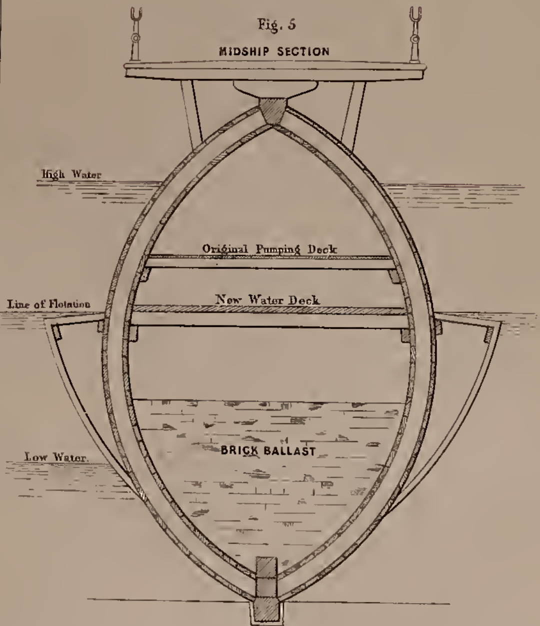
Engraved by C. Chabot.

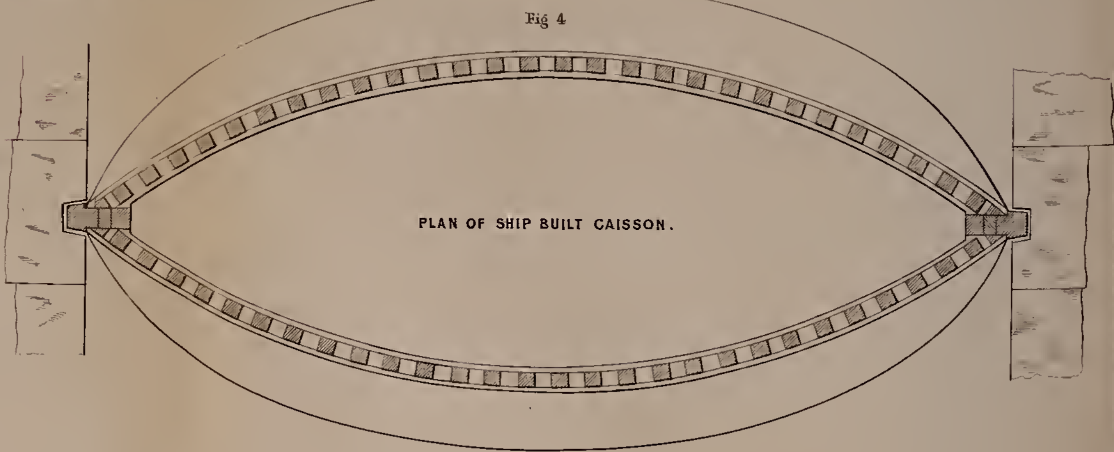
CAISSONS, H. M. DOCKYARD, SHEERNESS.











0 5 10 20 30 FEET

THE ARTIZAN.

No. CLI.—Vol. XIII.—AUGUST 1st, 1855.

CAISSONS FOR CLOSING WIDE ENTRANCES TO DOCKS.

(Illustrated by Plate 50.)

In continuation of the subject of caissons, we have the pleasure of presenting to our readers this month another example of these contrivances, and one possessing considerable interest when taken in connexion with the history of caissons. The object to which we have devoted this paper is to describe the self-acting caisson designed by Mr. Mitchell, late Civil Engineer of H.M. Dockyard at Sheerness, for which yard the first caisson upon this principle was built, so long since as the year 1833, and it is still in successful operation.

From the first construction of the new works—the present Dockyard—at Sheerness, on which Mr. Mitchell was engaged, there has been a caisson in use for closing the entrance to the Great Basin. The working of this caisson being attended with much inconvenience and expense, not devoid of risk, mainly on account of the necessity for pumping to raise it, appears to have directed Mr. Mitchell's attention at an early date to devise a remedy; and seeing how the capabilities of dry docks might be increased by throwing into them the extra length of the after-section, as well as a saving effected by adapting the caissons to supply the place of gates, he designed the one we have now to describe, and subsequently, after much opposition, obtained instructions to put one to the Graving Dock of that yard, although every step to that end was contested by dogged prejudice.

By these means that dock was converted into a very convenient dry dock.

As we here refer to a "Graving Dock," it may not be out of place to mention an error run into by some writers of the present day by the indiscriminate use of the terms "graving" and "dry" dock, as though synonymous; whereas in our arsenals, which may be regarded as the standard, there is as great a distinction in the terms, as between "tidal" and "wet" docks.

The term dry dock, then, strictly speaking, applies to such docks as, by having their entrances closed at pleasure by gates or other means of excluding the tide, admit of their foundations being laid at such a level as to receive ships of the draught of water required, such level being in no way restricted by that of low water. The term graving-dock, on the other hand, properly applies to a description of docks which, having neither gates nor other means of excluding the tide, cannot have their bottoms below the level of low water, and in which the tide flows and ebbs at pleasure, the use of the dock being merely for overhauling the bottoms of small craft, for which purpose sufficient time is allowed between tides; but in the case of repairs, and those often extending over months, the dry dock is had recourse to.

Between the two kinds of docks there is this marked difference, that whereas a dry dock can be constructed where there is no tide at all, a graving-dock wholly depends upon the range of the tide for its efficiency. To one of this latter kind the first caisson on the principle to be described was applied, thereby turning it into a dry dock.

Prior to the above date, it had been usual to construct caissons upon the principle of an ordinary vessel, with stem and stern alike, of which Figs. 4 and 5 (Plate 50) show a plan and section, being that of the one to the Great Basin at Sheerness, and having the *timbers vertical* and *planking horizontal*, by which means, it will be seen, an abutment was found for the timbers at one end only, in the grooves, and consequently one side greatly depended upon the other, as in a ship, for the power to resist the inclination to collapse with the external pressure of the sea; but the case is totally different from that of a ship, on which the water presses equally on all sides and equilibrium is maintained, to that of a caisson, where the pressure is generally on one side only, and to strut that by deck-beams from the other, is throwing the pressure on the weakest part, the inside of the arch, which of its own weight would fall to pieces but for the planking which straps it together.

In dock-gates, on the contrary, the timbers are placed so as to span the opening required to be closed, thus forming a vertical arch and offering the greatest resistance; the ribs in the heel-post abutting on the quoin at one end as a springing, and meeting in the mitre-post as a key stone.

In designing his caisson, then, it will be seen that Mr. Mitchell has regarded the groove on each side as an abutment, but, to avoid the expense of compass timber, and to apply the cheaper and more available light woods, such as Baltic and American, as well as for the convenience of framing and simplicity of workmanship required, he has substituted the truss for the arch in the form of his plan, Fig. 2, Plate 50.

Again, the stems of ship-built caissons, instead of being a main piece of the vessel, are simply bolted on to the dead-wood—see Fig. 4, Plate 50; and upon the strength of these bolts to resist the torsive action to which the stems are subjected, depends the stability of the caisson. Its weakness is evident by the caulking always working out of the stem-joint. On the truss principle, on the contrary, the stems are a main portion of the vessel, being formed of the butt-ends of what may be termed the tie-beam, and framed into it.

There are other advantages arising from the simplicity of construction in addition to strength, an important one being that of first cost, as will be seen by comparison in the two following cases:—

Cost of Ship-built Caisson at Sheerness, Figs. 4 and 5	£7,840	0	0
Cost of Truss-built Caisson at Chatham	2,272	0	0

The dimensions in both cases were the same—namely, extreme length, 62 feet; depth, 33 feet: but the truss-built one is subjected to by far the greater pressure, being to a dry dock, and, consequently, having the additional head from low-water mark downward against it—that is, average head at high-water against ship-built caisson, 18 feet, while that against truss-built is 25 feet.

The truss-built caisson shown in Plate 50 is of the same length as the above—namely, 62 feet over all—but is not so deep, being but 21 feet, and cost but £1,364 3s. 5d.

These caissons will therefore, we think, on the score of economy bear comparison with any in this or other countries.

It should be distinctly understood that this mode of construction is in no way indispensable in adopting the self-acting principle; the one being entirely independent of the other, though introduced together in the first instance.

Fig. 1, Plate 50, is a side view of Mitchell's caisson, a portion of the side being omitted to show the internal arrangements; Fig. 2 is a plan taken above the water-deck; and Fig. 3 is a midship section; the lettering in each case being the same.

It will be seen that the caisson is simply a hollow vessel, having a water-tight deck a few inches above the line of flotation. From it a 12-inch cast-iron pipe, A, passes through the hold and bottom, opening a communication between the sea and the upper side of the water-deck; B is a weighted valve, worked by a chain or rod from the gangway, for the purpose of opening and closing the aforesaid communication. Through the bottom are two other passages, D, D, closed by similar valves, and worked in like manner from the gangway. To afford ready means of access to these last valves, and to the hold, should it be required during the time the water-deck is ballasted with water, a trunk fitted with steps is formed from the man-hole in the gangway down to and through the water-deck, as shown in Fig. 3. The rods from the valves D, D, pass up through it, and it also acts as a vent for the air in the hold, which otherwise would be an impediment to filling the hold when sinking the caisson. The long triangular spaces, E, E, immediately above the keel, are filled with ballast.

The principle on which the caisson acts is this: The hold being kept empty, imparts to it a buoyancy and tendency to rise to the line of flotation; but as it would do so before the water was level on both sides, endangering its own safety and that of vessels in the dock, it is requisite to hold it down until the proper time arrives for removing, as also at all other times. For this purpose, water is admitted on to the upper side of the water-deck through the pipe A, and retained there by valve B, until, in the case of a wet dock, the tide has risen on the outside, or, in the case of a dry dock, until the dock is *filled:* the time having then arrived for opening the entrance, valve B is opened, the water flows off from the deck, and the caisson rises immediately out of the grooves into which it fits.

This action may be exemplified by the analogous one of a vessel shipping a sea. While the water is retained between the bulwarks, she rides deep; but so soon as the scuppers permit it to clear off, she rides to her ordinary line of flotation.

The water for ballast, let on to the water-deck, is in the case of a wet dock taken from it before the rising tide has any power of floating the caisson; and in the case of a dry dock, it is taken from the tide or external water before the dock is filled, occasionally at the previous high water, the water being entirely excluded from the caisson at all other times;—in the case of a dry dock, any tendency to float being more than overcome by the pressure against the grooves; but in a wet dock, the tide is allowed to flow in and out of the hold through one of the valves, D, thus effectually retaining it in its place.

To sink the caisson, valves, D, are opened, and water allowed to flow into the hold, and it at once descends into the groove; this water being let out of the hold again at low water, or when the dock, if a dry one, is emptied, when it is again ready for action.

It often happens that the invert of the dock-entrance being some feet below low-water level, the whole of the water cannot be run off from the hold of the caisson, as will be seen by reference to Fig. 5, which shows the original caisson at Sheerness altered to the self-acting principle by the insertion of a water-deck and other fittings; but it was found that the water left in the hold gave to her the action of a water-logged ship. This difficulty Mr. Mitchell obviated by using a material for ballast which should occupy the whole space, and for that purpose substituted for the original iron ballast brickwork and concrete, which was, we believe, the first instance of its application to that purpose, though it is now generally adopted. The saving in this was considerable, namely, 150 tons of iron ballast at £4 per ton, while the brickwork is fully covered by 10s. per ton.

Before these alterations were made, one hour and a half was occupied in pumping on each occasion of raising the caisson, fifty men, on an average, being required for the purpose, and the heaving and rocking motion caused by it, and the action of the tide and wind, conjointly, produced such an abrasion of the stems as to cause great leakage. To prevent it, lead, ½ and ¾ inch thick, and also ½-inch copper, were tried as sheathing; but, becoming torn and rolled down, it only increased the evil, which was not confined to leakage alone, since the stems, being thus unprotected, were subjected to the ravages of the Teredo. In America india-rubber has been tried with no better success.

Upon the self-acting principle, the caisson rising immediately, and with a regular, steady motion, the cause of the difficulty just described was removed.

In conclusion, the advantages possessed by this caisson may be stated as—

1st. Perfect action, independent of pumps for floating or external appliances for sinking it.

2nd. Saving of expense and time in working it, and of pumps and other fittings for the purpose.

3rd. Much greater strength, from the stems being part of the main body, and from the general arrangement of the framing.

4th. There is, comparatively, no wear-and-tear, the working parts being the valves only; and no wear-and-tear of the stems and keel by working against the groove during the time of pumping.

5th. Great saving of expense, as contrasted between Ship-built

Caisson	£7,840
And Truss-built	2,272

This caisson was found to act so perfectly, and so effectually to overcome the difficulties which had attended others, that, at Chatham Dockyard, new gates were taken down from a dry dock, by order of the Board of Admiralty, and a caisson on this principle substituted.

SUPERANNUATION OF THE CIVIL SERVANTS OF THE CROWN.

In our last number, we offered some remarks on the above subject, pp. 160, 161.

Our attention having been arrested by the Bill in question, we have thought it within our province of advocate of the interests and well-being of that extensive and important class of our fellow-countrymen, the devisers, leaders, and operators of technical and scientific industry, to seek information as to the actual treatment experienced by the servants of the Crown of all grades engaged in the direction and performance of the difficult and responsible duties of the technical and scientific departments of the National Service—viz., the Dockyards, Arsenals, &c.

Grieved are we to find that there are many and just grounds of complaint in the treatment experienced by most of that class of very useful yet unobtrusive servants of the public, amongst whom are many of high attainments as well as great skill.

Upon the general subject we shall feel it our duty to enlarge at a future period; at present we address ourselves to the case of but one section of the class, the professional Officers of Her Majesty's Dockyards; and in this interest even we must leave for another occasion sundry injustices to which they are subjected during their active career, confining ourselves to the mode and rate of apportionment of superannuation allowance meted to them from the fund which they themselves, in common with the other *employés* of the establishments, contribute to the creation and growth of.

For the information of such of our readers as may not be aware of the modes of estimating, rating, and paying the various classes of public servants officiating in those extensive and important establishments, we state that such servants are by official routine divided into two classes; the one professional—that is, the men of various grades engaged in the conception, direction, and performance of the technical and scientific works, the real objects of those establishments; the other class, Clerks employed in taking and keeping account of the doings of the first, and Storekeepers and their derivatives, engaged in taking care of those same works, when produced by the class we first allude to, and of the materials used in their production.

Now, to us it would appear—and so, we suspect, it will to most of our readers, both skilled and unskilled in the various difficult duties the heads and hands of the first have to perform, that *they* should at least *not* be the worst treated, lowest rated, or poorest pensioned of the two classes of *employés*. Sorry, however, are we to say, that such expectation will be disappointed, as will be seen by the subjoined comparative Table, which we have at much trouble elicited the materials for, and at some pains cast out. Upon the state of things there disclosed we at present make no comment, or raise any argument; it speaks sufficiently plainly for itself. We shall, however, by-and-by, take occasion to call the attention of our technical friends out of doors to throwing the weight of their interest and good feeling into the scale for obtaining that justice which is due to their brethren in the public service.

TABLE showing the comparative Servitude, Pension, &c., of an average case of a Professional Officer, with a similar one of a **Non-Professional Officer, Clerk, Messenger, or other Person,** *who may have been paid at a rate per Annum, instead of a rate per Diem.*

AGE At different Periods of Servitude.			SERVITUDE. Lost in acquiring a Profession.		SERVITUDE. Not reckoned for Pension, having been paid at a rate per Diem.		SERVITUDE. Reckoned for Pension, having been paid at a rate per Annum.		SERVITUDE. Total No. of Years spent in the Service.		Pensions calculated by the following Acts of Parliament, assuming the Salary at time of Superannuation to be £400 per annum. Act 3rd Geo. IV. cap. 113. On Salary before 4th Aug., 1829.		Act 4th & 5th Wm. IV. cap. 24. On Salary after 4th Aug., 1822.		LOSS Sustained by a Professional Officer per Annum.	
Periods of Servitude.	Officer.	Clerk, &c.	Officer.	Clerk, &c.	Officer.	Clerk, &c.	Officer.	Clerk, &c.	Officer.	Clerk, &c.	Officer.	Clerk, &c.	Officer.	Clerk, &c.	Geo.IV.	Wm.IV.
	Years.	Years.	Years.	Years.	Years.	Years.	Years.	Years.	Years.	Years.	£	£	£	£	£	£
On entering the Service	14	16	—	—	—	—	—	—	—	—	—	—	—	—	—	—
On completing Apprenticeship	21	16	7	—	—	—	—	—	—	—	—	—	—	—	—	—
When placed on Salary for Pension	39	—	—	—	18	—	—	—	—	—	—	—	—	—	—	—
When Superannuated	66	66	7	—	*18	—	27	50	52	50	233	400	166	266	*167	*100

* From this it is seen that the Period served by a Professional Officer, previous to his being placed on Salary, not being reckoned for Pension, causes a loss to him as follows, viz.:—

If placed on Salary before the 4th August, 1829, of £167 a year.
If ditto after the 4th August, 1829, of £100 a year.

TABLE showing the Pensions awarded to the Professional Officers, a **Non-Professional Officer, Clerks,** *and a* **Messenger,** *whose names are mentioned, with their respective Servitude, Salaries, &c., extracted from Navy Estimates for the year* 1855-56, *pages* 93 *and* 94.

From what Establishment.	NAME.	RANK.	SERVITUDE. On a Rate per DIEM. Yrs.	Mon.	On Salary for PENSION. Yrs.	Mon.	Total, exclusive of Apprenticeship. Yrs.	Mon.	Average Salary for last 3 Years. £	If contributed 5 per cent. to Superannuation Fund.	PENSION £	COMPARISONS AND REMARKS.
Admiralty	T. Waterman	Chief Draughtsman to Surveyor of the Navy	15	0	20	5	35	5	390	Yes.	161	A Professional Officer or Draughtsman of 35 years' servitude exclusive of Apprenticeship, making together 42 years, which did not give him even 5-12ths of his Salary, yet the **Messenger** with 57 years' servitude retires on full pay, and could have done so 7 years earlier had he then been incapacitated for duty.
Admiralty	G. P. Laplume	Messenger	—		57	5	57	5	250	No.	250	
Portsmouth Dockyard	Wm. Blessley	Foreman of Shipts	25	7	18	0	43	7	250	Yes.	108	The Professional Officer had 2 years and 10 months less servitude, but an equal or similar Salary; yet he was only awarded one-half the Pension of the **Clerk.**
Portsmouth Dockyard	Wm. Gettens	Clerk	—		46	5	46	5	250	No.	216	
Woolwich Dockyard	S. Fullagar	Timber Inspector	7	9	42	6	49	10	400	No.	200	The Professional Officer had 8 years more servitude and £85 a year more Salary, yet he was awarded £75 a year less Pension than the **Clerk.**
Woolwich Dockyard	*John Lee	Clerk	—		42	0	42	0	315	No.	275	
Portsmouth Dockyard	†John Fincham	Master Shipwright	8	6	41	6	50	0	650	No.	527	The Professional Officer had 10 years more servitude and £50 a year more Salary, yet he was awarded £36 a year less than the **Storekeeper.**
Chatham Dockyard	John Miller	Storekeeper	—		40	0	40	0	600	No.	563	

* Will appear in the Navy Estimates for 1856-57. † See Navy Estimates for 1854-55, page 79.

MATHER'S EARTH-BORING MACHINERY.

In our June Number, we gave a Plate—No. xliv.—illustrating this important invention. In the present Number we give a Plate—No. xlix.—with the details of the boring-bar and shell-pump: both contrivances are found practically to answer thoroughly.

The machine exhibits, as we have already stated, much ingenuity; and the results of its numerous applications to the purposes for which it is intended, demonstrate its practical usefulness and value as an economical application of power for earth-boring.

We understand that it is in constant and profitable use, and that it is about to be applied to a systematic series of borings throughout an extensive district, the results of which are expected to be of extraordinary interest to the scientific world.

The Paper read at the Society of Arts, May 30th, and reported by us in the June Number, will supply a general outline of the machine and the tools employed in connexion therewith, but does not sufficiently explain the construction and working of the machines and tools as drawn by us, and given in Plates xliv. and xlix.: we therefore adopt the description of the invention, and the method of working it, as set forth in the Specification of Mr. Mather's Patent.

Plate xliv. shows a longitudinal section, plan, and end view of the machinery. On these three views the same letters and figures of reference are placed on corresponding parts. 7, 7, 7, the framework of the machine; A, the steam cylinder for actuating the boring head; 4, boring head; 5, lifting cylinder or bucket; B, square piston-rod, with fork, C, for carrying the pulley; D, top pulley; W, screw-clamp, for holding the rope whilst the operation of boring is going on, which, by means of a screw, can be moved, so as to give out the rope, and allow the boring head to descend as it penetrates the rock. On the shaft of this screw are two bevil-wheels, which are geared into two other bevil-wheels, which, by means of short shafts and handles, can be operated upon from the stage at 9, or the floor-level. V, guide pulley; Y, large pulley or drum, for winding up and lowering the boring head, and also for working the lifting cylinder or bucket; 3, rope; Z, spur-wheel to winding engine, 2, there being a spur-pinion on the fly-wheel shaft, which takes into and drives the spur-wheel, Z; F F are two square shafts, on which the cams or inclined surfaces, C, H, I, K, are fixed, by which the valves are worked: these cam surfaces are capable of sliding on the shafts F, F, and are fixed in any position by set screws, so that a longer or shorter stroke may be given to the piston in the cylinder A, according to the hardness or softness of the material in which the hole is being bored; S, tappet or arm, fastened on the square piston-rod, which, as the piston-rod ascends, slides over the surfaces of the inclined cams, and so turns the square shaft F, and by means of an arm causes the steam-valve to open and shut: the exhaust-port is actuated in a similar manner. It will be observed that the steam-port, O, is level with the bottom of the cylinder, while the exhaust-port, N, is a few inches above; and, by this arrangement, when the piston in its descent passes the exhaust-port, the steam contained in that part of the cylinder between the bottom of the port and the bottom of the cylinder acts as an elastic cushion for the piston.

In Plate xlix., Fig. 4 is a transverse section of the boring bar; Fig. 5, an elevation: Figs. 6, 7, 8, 9, and 10, are cross sections, corresponding with the letters marked on the transverse section. *a, a, a, a*, is a bar of wrought-iron, of round section in the parts *a, a, a, a*, but square from *b* to *c*; *d* is the link by which the whole is suspended, attached by means of four cotters to the part *e, e*, the lower part of which, from *f* to *g*, is of square section, but twisted. One-fourth part round beyond this twisted portion is another parallel square part, marked *h*. *i* is an outer box or cylinder; *k* is an inner box or cylinder; *l*, a ratchet-wheel, with boss projecting downwards; *m*, ratchet-wheel; *n*, a casting attached to the bar, serving to add weight to the boring head, and to act as a guide to keep it perpendicular in the hole; *o*, boring head, in which the cutters are fixed; *p, p*, cutters; *q, q, q*, india-rubber springs, to break the concussion of the parts *r* and *s* when the boring head is raised. *r* is a collar fixed to the top of the bar *a*; *s*, a gland or ring over the india-rubber springs *q, q, q*.

The object of the arrangement of parts above described is to cause the cutting part of the boring head to revolve a portion of a revolution at each stroke, which is thus effected:—When the bar is resting at the bottom of the hole, and the link *d* is raised, it will pass through the space from *s* to *r* before it raises the bar, carrying with it the part *e, e*; but, in so doing, the twisted portion of the bar *a*, above described, in passing through the socket of the outer box *i*, is compelled to make a partial revolution, which puts a corresponding twist in the rope, which, when the weight of the boring head comes upon it, has a tendency to straighten itself again, and so causes the boring head to revolve.

The parts *i, h*, and ratchet-wheels *l, m*, are caused to act in the following manner, to prevent the possibility of the rope being twisted and untwisted without producing the effect desired:—When the part *e, e*, is raised, and caused to move round by the twisted part *f, g*, as above described, the square part *h* carries round with it the inner box or cylinder *k, k*, in the direction shown by the arrow in the cross section C, D, which is allowed to pass easily in that direction by the slipping of the catches, which take into the teeth of the ratchet-wheel *l*, as shown; whilst, in descending, the casting *e, e*, is prevented from revolving in the opposite direction by the square part *h* passing through the socket of the inner box *h*, which cannot revolve in that direction without carrying with it the ratchet-wheel *l* and the whole of the boring head, by acting on the bar to which it is attached; but as it cannot revolve in consequence of the cutters being at that time imbedded in the earth, it causes the outer box *i* to revolve in the direction shown by the arrow on the cross section E, F, which is also retained in its position, and prevented from returning by the catches and ratchet, as shown.

Fig. 12 is a transverse section of the lifting cylinder or bucket; Fig. 13, an elevation; and Fig. 14, a plan of the same. *a* is the forked pump-rod, which serves also as the link by which the pump is raised or lowered; *b*, bucket; *c*, india-rubber valve to same; *d, d*, india-rubber springs, to break the concussion, and prevent the nut *e* coming in contact with the frame *f*, by which the seating of the bottom clack or valve is fastened to the spindle *i*; *g*, bottom india-rubber valve or clack; *h*, seating for same; *i*, spindle, which passes through the frame or guard *f* and the bucket *b*, and is retained in its place by a cotter, *k*; *l*, frame, which passes over the top of the pump, and serves as a guide for the spindle *i* and forked pump-rod *a*; *m*, the outer casing or pump-barrel. When the lifting cylinder or bucket is passing down the hole, the piston of the bucket will be at the top of the working barrel, and the whole suspended by the collar of the frame *l*, bearing on the closed part of the forked pump-rod immediately above the bucket; but when it reaches the bottom, the piston of the bucket will descend by its own gravity till it comes to the position shown in the drawing. When the motion of the winding engine is reversed, the bucket will be raised, and a partial vacuum formed below it, when a portion of the rock, which has been removed and broken up by the cutters, will be carried by the flow of water past the bottom clack or valve *g*, into the space between it and the bucket; to facilitate which, the bottom clack or valve, instead of being secured to the seating in the ordinary way, is fastened to a tube, which is at liberty to slide in the bar *i* as far as is allowed by the slot in the tube, and the cotter in the spindle, as shown at *o*. When the pump is raised to the surface, and placed on the stand provided for it, and the cotter *k* knocked out, the bottom clack or valve *g* with its seating *h* will descend, and the contents be washed out by the flush of water contained in the lifting cylinder or bucket. The operation of boring is thus performed (see Plate xliv.):—The boring head having been lowered into the hole, the rope is secured by means of the clamp *w*; the stop-valve is opened, and a small jet of steam is introduced below the piston, which is slowly raised till the projecting arm or tappet *s* comes in contact with the cam *h*, which is so formed, that the tappet *s* in passing along the surface causes the rod *e* to turn partially round, and thereby open the steam-valve, and admit a sufficient quantity of steam to raise the piston more quickly, till the tappet *s* comes in contact with another cam, *g*, of similar form to the former one, but in a reverse position, which closes the valve; whilst at the same time on the opposite side of the piston-rod is another tappet, which opens the valve for the exhaustion of the steam in a similar manner. When the piston descends, and the boring head falls with all the impetus of its own gravity upon the rock or substance into which it is intended to bore, the cutters will penetrate and disintegrate the said substance. This operation having been repeated as many times as the workman by experience considers necessary, the clamp *w* is released, and the boring head is brought to the surface by means of the winding engine, 2, and a hook at the end of a long rod, similar to the one marked 6, but not shown in the engraving (by which the lifting cylinder or bucket is suspended, and hangs from the sliding hook), is passed into the link of the boring head, which may then be placed on one side; the hook is then to be disengaged from the boring head, and attached to the lifting cylinder or bucket, which is then lowered to the bottom of the hole or boring, and the piston of the bucket is to be raised and lowered three or four times. By reversing the winding engine, the lifting cylinder is then to be raised to the surface, and, without disengaging the hook, it is attached to the link of the lifting cylinder, and the engine being reversed, the rod will receive the weight of the lifting cylinder until it comes into the position as shown in Plate xliv., the bottom of it resting on the small table: the cotter is then knocked out, and upon turning the fly-wheel, the screw acts upon the lever; the table being lowered, the bottom clack follows it, and the whole of the contents of the pump will be delivered into the box. For the purpose of effectually cleansing the clack, there are four jets of water under pressure, which being turned on at the time the table is being lowered, will wash away any sand or other material that may lodge on it. The lifting cylinder or bucket requires to be introduced into the boring three or four times to raise all the loose matters; and when the workman finds that the boring is well cleaned out, the boring head is again attached to the hook, the rope securely clamped, and the operation repeated as before.

In conclusion, we now add, in confirmation of what we have said in favour of this invention, that another month's working has further tested its value and extended the field of its usefulness, and we watch the progress it makes toward being generally adopted with considerable interest.

CHARCOAL AS A DEODORISER AND DISINFECTANT.

The remarkable and valuable property which charcoal of all kinds possesses of absorbing and neutralising the noxious exhalations from decomposing vegetable and animal substances, is one of which the knowledge is not new to science, although the practical application of it to ordinary common-life purposes is now only in the course of operation. It is only now, indeed, that advantage is slowly being taken of the natural peculiarities of this substance — peculiarities which are so important in a sanitary point of view, that the only source of wonder is, how it happens that we are so late in availing ourselves of a means of purification, and consequently of health, which nature thus bountifully supplies. There are, at the present time, but few subjects of popular interest upon which so much has been written and said as upon sanitary reform in all its multitudinous phases. Perhaps we shall not be much in the wrong, if we go a little farther, and say that there is none in which the public of all large or thickly-inhabited towns are so intimately concerned, and none to which individually they are more indifferent. It is a remarkable fact, that even among the better informed there exists but a very imperfect appreciation of the conditions and circumstances upon which, in connexion with the cleanliness and ventilation of our towns and houses, the health of the population is more or less dependent; and nothing is more difficult than to convince individuals of the lower class that the infected atmosphere of their confined and crowded dwellings is charged with an insidious poison which, when it is inhaled day after day, produces in the system a state of nervous depression which renders those who have been subjected to its deleterious influence so far obnoxious to the attacks of disease, that notoriously unclean and ill-ventilated localities are seldom free from the visitation of fever and other epidemic disorders. In this, as in all other cases, long familiarity with the danger robs it of its terrors; and as the effects are not immediate, we live on blindly unconscious of the mischief which is in the daily and hourly course of perpetration; or if we by chance are endued with a glimmering of the truth, still we hope that the evil day may be indefinitely postponed wherein we may be called upon to pay the penalty for despising and setting at defiance the natural laws which ordain that cleanliness and fresh air are indispensable to our healthy being.

When a number of individuals are congregated together, the deterioration which is speedily effected in the atmosphere by which they are enveloped arises from two distinctly different causes. In the first place, there is that normal deterioration which is produced by the consumption of the vital principle of the air, and its substitution by an irrespirable gas in the natural act of respiration; in the second place, comes the deterioration arising from the continued exhalation of volatile animal matter from the skin and lungs of the persons present. The change produced in the air by the first-named action is definite. A certain amount of oxygen, which is the life-sustaining principle, is taken away, and an equal volume of carbonic acid is returned into the atmosphere in its place. The latter, it is true, cannot furnish for one moment the means of respiration, but it differs altogether from the poisonous miasmata which are produced when an atmosphere is charged with animal exhalations, or the products of animal or vegetable decomposition. The effect of such effluvia upon the wholesomeness of the air is altogether indefinite: these gaseous or vaporiform principles are composed of elements which possess a Protean power, and having, in all probability, the property of acting as ferments, they may, and no doubt often do, operate directly as blood-poisons. The true nature of the action of atmospheric poisons upon the animal system is very obscure; but their effects are too strongly and distinctly marked to allow of any doubt existing as to the potency of their influence. In the case of what are known as poisonous gases, the extent of the action has been subjected to actual experiment—with sulphuretted hydrogen gas, for example, a comparatively minute admixture of which is found to render atmospheric air destructive to life. It is not, however, necessary that a poisonous atmosphere should produce immediate fatal effects, to prove that its influence is in the highest degree deleterious: indeed, the substances which are most direct and energetic in their action are, perhaps, those against which we can most easily protect ourselves. No one would venture into a room where he knew the air to be highly charged with sulphuretted hydrogen or carbonic acid. The known virulence of these gases would prevent any one from risking his life by inhaling them, and their effect upon respiration, upon the least attempt being made to inspire them, would be a sufficient warning of the danger of continuing the experiment. These poisonous gases act, in the first instance, upon the respiratory organs, and, secondly, upon the nervous system; but the poisonous effluvia arising from vegetable and animal decomposition, the exhalations of sewers and cesspools, and the fœtid air of closely-inhabited and ill-ventilated dwellings, operate in a different manner. It is now a well-known fact that, by the introduction into the system of matter in a certain stage of decay, in what has been termed by Liebig the state of cremacausis, the most direful effects may be produced — effects which generally have a fatal termination. The most striking instance of this kind of action is the poisoning, so peculiar in its nature, which sometimes occurs in Germany, in consequence of eating sausages which are undergoing slow decomposition. This is well known as the sausage-poison. The production of that extraordinary disorder, dry gangrene of the extremities, in individuals that have fed upon bread made from rye affected with the disease called the ergot, is another example of a similar action, although the effects are very dissimilar. The hands and feet of persons thus affected become dry, withered, and quite black: they undergo, indeed, a peculiar species of mortification, and ultimately drop off unless they are removed by means of art. In certain localities on the Continent, under the influence of peculiar seasonal conditions, this disorder has occasionally become quite epidemic, although fortunately it is but little known to England. In these cases the poisonous influence is exerted upon the blood, and it is the same with the action of miasmata.

Most of the malarious poisons seem to act thus, first entering into the circulation, and then reacting upon the nervous system: great depression and constitutional debility are the consequence, so that individuals who have been exposed for any length of time in ill-ventilated rooms, or wherever any source of atmospheric deterioration is in operation, can scarcely hope to escape from the attacks of those diseases the germs of which are constantly surrounding us, and from which we are only protected by assisting nature to maintain intact her normal resisting forces. In large towns, where thousands of individuals are, in the mere act of living, producing a more or less poisonous state of the circumambient air during every moment of their existence, of course the question of sanitary measures is of great importance; but one thing is certain, that an effectual reform in connexion with this subject must rest much more with the individuals who compose the community than with any Government measures, whether general or local. If such be the case, is it not desirable that the public should possess a more general knowledge of the means of destroying miasmata, and of preventing the evolution of the poisonous gases, which, diffusing themselves in the atmosphere of close dwellings, vitiate the air and diminish its power of acting as a vital stimulus? There are many substances known to the chemist which are distinguished by possessing what are termed antiseptic properties: that is, they possess the power of checking or impeding decomposition in other bodies; they are, in fact, powerful conservators. There are a few other substances which add to this antiseptic power another still more remarkable: this is the property of absorbing and firmly retaining the fœtid exhalations and products of decomposition, so that an infected atmosphere, or solid or fluid matter, may be rendered sweet and wholesome by their mere contact. The substance which enjoys in the highest degree these conjoined powers is that which we named at the commencement, viz., common charcoal. Perhaps there is not within the range of chemistry a more remarkable instance of the forcible influence which one sort of matter is capable of exerting over another, than is to be found in the action of charcoal upon gaseous bodies of every kind. Under ordinary circumstances, and relatively to mechanical forces, we know that the mere condensation of the permanent gases into a very greatly diminished bulk is a problem not too easy to solve. How extraordinary and powerful must, then, be the attractive force which not only condenses these gases to a most remarkable extent, but which is capable of retaining them for an indefinite period in this state of condensation! It has been ascertained, by experiment, that freshly-burned wood charcoal placed in an atmosphere of either of the following gases will, in the course of twenty-four hours, absorb the quantity stated in the table.

Ammonia	90	Bicarburetted Hydrogen	35
Muriatic Acid	85	Carbonic Oxide	9·42
Sulphurous Acid	65	Oxygen	9·25
Sulphuretted Hydrogen	55	Nitrogen	7·50
Nitrous Oxide	40	Carburetted Hydrogen	5·00
Carbonic Acid	35	Hydrogen	1·75

The numbers indicate the number of volumes of gas respectively which one volume of charcoal can absorb; but it may be remarked that the extent of the absorptive action increases as the temperature at which the experiment is made diminishes. The action is also not confined to these substances while they are in the free gaseous state; those which are soluble in water are removed from their solution by the same means; so that water contaminated by the gases which arise from rotten vegetable matter is rendered perfectly pure and inodorous by mere filtration through a layer of charcoal, or even by placing a few pieces of fresh charcoal in the vessel containing it. Unlimited experience has shown that the most fœtid substances may be rendered perfectly odourless and innoxious by means of charcoal; and what, we would ask, can be more valuable, in a sanitary point of view—or rather, what may be more valuable, if we chose to avail ourselves of it to the utmost—than the knowledge of this fact? The dangerously unwholesome state of the densely-crowded parts of populous towns arises from the accumulation of malarious exhalations, in consequence, first, of the overcrowding of the dwellings, and secondly, from the want of proper sewerage and ventilation. If any cheap and ready means could be employed for preventing or destroying these exhalations, how much may be done towards assisting and establishing a complete and effective sanitary reform!

In speaking of the practical application of charcoal to this purpose, we must consider it as possessing the distinct properties both of an *antiseptic* and of a *disinfectant;* and it is in this respect that the use of charcoal is particularly advantageous when compared with that of the chemical agents which may be employed for a similar purpose. In an infected atmosphere it is well known that provisions are more prone to run into a state of decomposition than when the air around them is fresh and pure. It is, therefore, difficult to preserve either solid food, or even water, in a state fit for human consumption, where the atmosphere is charged with poisonous effluvia, as is so often the case in dwellings of a certain class. Under such circumstances, what a valuable sanitary agent charcoal may be rendered by virtue of its *antiseptic* properties! Meat, fish, or any matter readily obnoxious to decay, may be preserved for a very considerable time if kept surrounded with pieces of charcoal; and even if incipient decomposition be established, it may, in a similar manner, be immediately checked, and the material rendered wholesome and fit for food. As a *disinfectant,* charcoal is even more effective. The admixture of charcoal in powder with the contents of cesspools or sewers will wholly deprive them of odour; the most fœtid sewage liquor, mixed with a little charcoal powder, and afterwards filtered to remove the solid matter, could not be distinguished from the purest water, either by appearance or smell. It is the same with the soil from cesspools: after being mixed with a proper quantity of charcoal, every trace of mal-odour is removed, and the mixture may be transported from place to place without the least offence against public convenience or prejudice to the public health. The mere scattering of a layer of the powdered charcoal over the surface of soil effectually prevents the effluvia from escaping, and, undoubtedly, the exposure of a considerable surface of the same material, in shallow trays, for instance, would in a great measure, if not entirely, purify the infected atmosphere of ill-ventilated dwellings.

The powerful action of charcoal upon gases and vapours is not limited to them; it extends to many organic principles, as, for instance, the colouring matter of vegetable infusions, and even to the principles upon which the peculiar flavour of certain vegetable matters depends, such as the intense bitter of gentian and quassia. What renders this action the more remarkable, is the fact that it appears to be entirely independent of ordinary chemical action. The charcoal effects no change in the matters over which its influence is exerted—it merely seizes upon them by virtue of some powerful surface attraction; but any substances thus retained by charcoal can be easily re-obtained in their normal character by the employment of certain chemical means. Neither is the disinfectant property confined to any particular kind of charcoal. That obtained from the various bituminous minerals appears to act as well as that from wood, but the charcoal from peat is perhaps that most suitable to sanitary purposes. An excellent charcoal may also be manufactured from spent tan; and in the neighbourhood of large towns, many refuse matters may easily be burned into a material which will operate extremely well as a disinfectant.

In France this substance has been largely employed for the last fifteen years as an adjunct to sanitary purposes, in the purification of water. It affords a ready means of effecting the latter; and it is greatly to be desired that its excellent properties, both in this respect and as a disinfectant, should become generally known.

H. M. SCREW STEAM-SHIP "MARLBOROUGH," 131 GUNS.

The ordinary routine of Portsmouth Dockyard was, the other day when we visited it, giving place to the bustle and excitement consequent on the approaching launch of the *Marlborough*, the largest ship-of-war which the English Navy can boast of; and before The Artizan can be put into the hands of its numerous readers, this magnificent specimen of England's wooden walls and steam floating batteries will have passed into its own element, with all the *éclat* which the presence of England's Queen and Court can so gracefully bestow, and amid the applause of thousands of gratified spectators.

The following are a few of the principal dimensions of the *Marlborough*:—

Guns . . .	131
Tons . . .	4,000
Length between the perpendiculars	245 ft. 6 in.
Breadth extreme . . .	61 ft. 2 in.
Height between decks . .	6 ft. 2 in. from deck to beam.
Total „ „ . .	7 ft.
Total depth from upper deck to keel.	53 ft.

The following are a few dimensions of the machinery, &c., by Messrs. Maudslay, Son and Field:—

Nominal horse-power . . 800

The boilers are in six separate pieces, with four furnaces in each, the uptakes leading into one single chimney.

The screw-shaft is $15\frac{1}{2}$ in. diameter; the pitch of the screw is about 26 ft. 3 in.; the diameter of ditto, about 19 ft.

We hope to have the pleasure next month of presenting to our readers full particulars of the machinery, with a few remarks thereon, and a report of the trial of this magnificent ship.

TRIAL OF THE NEW "VICTORIA AND ALBERT" ROYAL YACHT.

In our notice of this vessel in last month's "Artizan," we remarked that the engineers had justly appreciated the fact that the boiler is the *source of power.*

This remark has been fully borne out by the trial, at the measured mile, of the yacht at Stokes Bay, on Monday last, the 23rd ultimo.

The following are the facts, as reported, of this trial:—

Mean speed of vessel, 17 knots, or 19·6 statute miles.
Revolution of the engines, 25·4.

So that, taking the mean pressure at about 22 ft. per square inch of the piston, we have an indicated power of about 2,800 horses.

We cheerfully congratulate Messrs. Penn and Son on the very satisfactory results of this trial; it certainly reflects great credit on the already fair fame of that firm.

We have heard it stated, that notwithstanding the pistons were travelling at 350 feet per minute, there was a large *surplus* of steam under very fair stoking.

We have also heard that the paddle-float, which we gave in our last as 5 ft. $1\frac{1}{2}$ in. broad, has been reduced in the course of the preliminary trials 11 inches, to allow the engines to get away.

We would humbly inquire that as the bugbear high-pressure has disappeared, why did they not retain the original size of the float, and *increase* the pressure a few pounds? Had this been done, we have no doubt but the speed would have been still higher, with greater economy.

AMERICAN NOTES.—No. VIII.

Steam Fire Engines.—The necessity of resorting to the use of engines of this description is becoming so apparent to the authorities of our large cities, that quite an impetus is being given to the mechanical talent of our country competent to or disposed to give this subject their consideration.

New York, Cincinnati, and Boston have all made essays, and New York is now about offering a premium of one thousand dollars for the best design of an engine of this description.

The following is a report of what has lately been done in this way :—

The "Cincinnati Commercial" contains the report of a Committee of citizens to witness the performances of a new steam fire-engine, named "Young America," and built in the machine-shop of Abel Shawk, and according to his patent. In this report it is stated, that in twelve minutes exactly, from applying the match, the engine commenced its work, and the pumping of water began. The first experiment was made by using a nozzle 1⅛ inches in diameter, playing horizontally, the water being thrown 210 feet. The next experiment was with a nozzle 1¼ inches in diameter, in the same direction. Upon actual measurement, it was found that the water had been fairly thrown a distance of *two hundred and twenty-nine feet and four inches.* It also forced a stream of water through the 1¼-inch nozzle ten feet over the tower of the Mechanics' Institute, 160 feet high ; and had the wind not been so strong, it would have thrown the stream higher still. The Committee, after a number of experiments, unhesitatingly declared, they were perfectly satisfied, and considered the engine a triumph of which Cincinnati might be proud.

Steamer "Metropolis."—This new boat of the Bay State Line, running from New York to Fall River, R. Island, has commenced service upon her route; and, as the largest single-engine steamer yet built, the following elements of her dimensions and capacities are interesting :—

STEAMER "METROPOLIS."

Built by Samuel Sneden, New York; Engines by Novelty Works, ditto.

Length on deck	347 ft.	0 tenths.
Breadth of beam (moulded)...	45	8
Ditto, over guards	82	0
Depth of hold...	16	0
Hull / Engine-room }	2,108 tons.	

Kind of engine, vertical beam ; do. boilers, vertical tubular ; diameter of cylinder, 105 inches ; length of stroke, 12 feet ; diameter of paddle-wheel over blades, 41 feet ; length of blades, 13 feet ; depth of do., 2 feet 6 inches ; number of do., 32 ; number of boilers, 4 ; length of do., 20 feet 8 inches ; breadth of do.—two 13 feet 3 inches, and two 12 feet 3 inches ; height of do.—two 13 feet 3 inches, and two 12 feet 3 inches ; height of steam-chests, 8 feet. Number of furnaces, 2 in each boiler ; length of fire-bars, 7 feet ; internal diameter of tubes, 2⅛ inches ; diameter of chimneys, 6 feet ; height of do., 42 feet ; do., above grates, 62 feet ; average load on safety-valve in lbs. per square inch, 24 lbs. ; area of immersed section, 460 square feet ; do., grate surface, 300 square feet; do., heating surface, 12,000 square feet ; dip of water-wheels at load-line, 5 feet ; contents of bunkers in tons, 75 ; consumption of coals per hour, 3 tons ; draught forward (load), 10 feet 6 inches ; do., aft (load), 10 feet 6 inches ; average revolutions, 15½ ; point of cutting off, 4 feet ; weight of boilers, without water, 108,600 lbs. Floor timbers, moulded, 20 inches ; sided, 20 inches, and 24 inches apart. Masts and rig, none. Intended service, New York to Fall River.

Remarks.—Construction : a blower to each of the boilers, but they are seldom required. Hull : braced with iron straps, double, and diagonally laid. Above her main-deck is a state-room deck, running fore and aft, and enclosed all around.

By the above, it will be seen that, with a pressure of steam of 24 lbs. per square inch, cut off at one-third of the stroke of the piston, the unusual velocity of periphery of wheel of 22·73 miles per hour is attained (exceeded only by that of the *Leviathan,* as given in the January number, p. 5, which is 23 miles) ; and in order that this speed may not be considered to be obtained by an insufficient surface of water-wheel blades, a reference to the above dimensions will show that the surface of each blade is no less than 32 feet 6 inches, giving 65 feet area of blade to 460 of immersed section.

For the information of your domestic and European readers, it is not amiss to note here, that the route of this boat is not that of a river ; for it is through Long Island Sound, and for a distance of 20 miles open to the ocean.

Steam Boilers.—Herewith is a drawing of the boilers adopted by the United States Government for the six steam-frigates now building (see Plate xlviii.) The plan is essentially that of the boilers adopte dby Mr. Collins for his line, the modifications being those of the tubes being placed over the grates, instead of in a line with them, and the conformation of the boiler such as to admit of their being placed athwartship, whereby a common fire-room for all of them is had, and the width of grates is not restricted by the width of the vessel, as in the other arrangement. This design of boiler is that of Mr. D. B. Martin, Engineer-in-Chief of the Navy, and in its combination it was considered sufficiently novel by our Patent Office here to justify them in the issue of letters patent to him : therefore, it has been approved of by Mr. Collins, and will be adopted in the new steamer of his line now in progress of construction.

The boilers shown in the plate are 11 feet 3 inches in length by 14 feet in width, and 14 feet 3 inches high ; each has 1,400 brass tubes, 2 inches in internal diameter, and 39 inches in length : the total grate-surface is 320 square feet, and the fire-surface 12,000.

It is to be hoped that the results obtained by the use of vertical tubes in the Collins Line—by several steamers built by Captain R. F. Loper, of Philadelphia—by the *Metropolis* and *Ericsson*—the further experience about to be had by the use of boilers of this character in the six United States steamers now building, and the new one for the Collins Line, will have the effect of waking up some of our engine-builders to the absurd fallacy and wasteful expenditure of flued boilers, and to the enormity of the loss of space in a sea-steamer consequent upon a round shell. The tenacity with which our manufacturers have adhered to an arrangement and form of boiler so opposed to all the requirements of marine engineering as that of flues in a round shell, frequently encumbered with a blower for the purposes of artificial draught, is nothing short of a barbarism—one of those idiosyncracies of the professions which we, in common with our Transatlantic brethren, sometimes indulge in ; as, for example, the use of steam-jackets ! and a pressure of steam restricted to 3½ lbs. per square inch ! boilers with rectangular flues, returning upon a common level with the grates, &c. &c.

Novel Method of Gearing.—There has been lately patented here, by Messrs. Dibben and Bollman, a novel and very ingenious plan of gearing, suited to propeller engines, lathes, &c. &c. The right to use this on the River Delaware was sold to a company not long since, who introduced it into a new steamer they were then building, and the result of this essay is of the most successful character.

Its design is as follows :—A bevel pinion works into a fixed bevel wheel with internal teeth, which wheel does not rotate, but is securely fastened by flanges cast upon its base. The pinion is keyed on to a shaft (an intermediate one between the engine and propeller), which is attached at the other end by a universal joint. The pinion end of the shaft has a journal upon it, which is fitted to the brasses of the end of a crank upon the propeller-shaft ; the centre line or axis of the intermediate or pinion shaft, therefore, makes an angle with the plane of the line of shafting, and the ratio of speeds is not alone determined by the relative number of teeth in the wheel and pinion, but by their difference divided into the number of those in the pinion it is thus arrived at.

The number of teeth in the wheel being 50, and in the pinion 40, the difference is 10 : therefore, 10 : 40 : : 1 : 4, which will be the relative speeds of the engine and propeller. In a subsequent letter I shall furnish you with diagrams of this arrangement, and further notes of its introduction.

Slip Modelling and its Inventor.—The "Nautical Magazine" of this city has lately furnished us with some light upon this interesting subject. It reads as follows :—

The universal use of the slip or water-line model in the United States, and the increasing favour which it finds at the hands of shipbuilders in all countries where its utility has been tested, renders it an interesting question—when, where, and who made the *first* model of this description ? For the sake of placing upon the record whatever information may be in our possession respecting the origin of this simple and most useful invention for obtaining the bodies of vessels in rotundity, we give place to the following letters from a New York shipowner, whose interest in maritime subjects is only equalled by his enterprise and success in their prosecution. It will be seen that Mr. Griffiths had been making inquiries concerning the inventor of the slip or water-line model, at Salem and Newburyport, when he was writing his "Treatise" upon "Marine and Naval Architecture," in 1850, and to which the following letter refers :—

J. W. Griffiths, Esq. : *New York, April 29th,* 1851.

Sir,—I have just returned from Newburyport. Mr. James L. Townsend told me you had, last winter, been there, endeavouring to find out who was the first person that built ships or vessels from slip models. During my late visit, to examine a ship Mr. Townsend is building for me, an old gentleman, 88 years of age, an old shipbuilder, came to Mr. Townsend's ship-yard—he built the *Alliance* frigate during the Revolutionary War, and the *Wasp* during last war—he invited Mr. Townsend and myself to visit him at his house. We went accordingly, and he placed in my hands a slip model made by him during the years 1794, 1795, or 1796—the exact year he could not remember. His name is Orlando B. Merrill, and was born in the year 1763. It was from Mr. Merrill that Mr. Dutton got his ideas about models. I understand that the late Isaac Webb, and Mr. Stephen Smith (Smith and Dimon), both claim the merit. It is evident that Mr. Merrill had used the slip model when these gentlemen were mere boys. I told Mr. Townsend I would communicate these facts to you on my return to New York.

97, *Wall-street.* Yours truly, David Ogden.

The following letter shows that Mr. Ogden subsequently procured the above-mentioned model, which is still at his offices in this city:—

J. W. Griffiths, Esq.: *New York, July 28th,* 1851.

Dear Sir,—I have now at my office, 97, Wall-street, the original slip model I spoke of some time ago. It was made by Orlando B. Merrill, in 1794, and I presume that it was the first made in this country. Mr. M. is now alive, and is 88 years of age.

Yours truly, D. Ogden.

Mr. Merrill died in 1854, at an advanced age. We intend to publish the draught of the model now in the possession of Mr. Ogden, with his permission, to illustrate American ideas of modelling 61 years ago upon the shores of New England.

Novel Method of Blowing off Saturated Water.—Mr. Hiram Strait, of Covington, Ky., has just patented a method of blowing off the saturated water from steam-boilers, which is so novel in its design, and so capable of attaining the end sought, that, notwithstanding some objections to its mechanical practicability, it is proper to place it upon record, as the germ of an arrangement in the construction of steam-boilers, possessing efficiency, and capable of being rendered, with modifications, perfectly practicable.

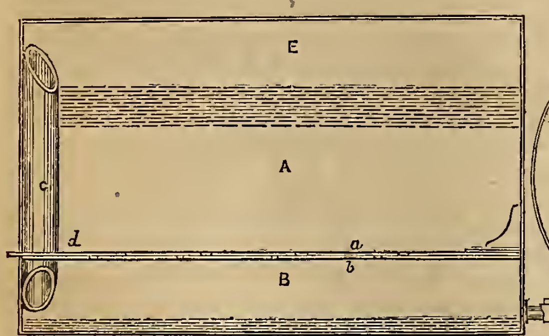


Fig. 1.

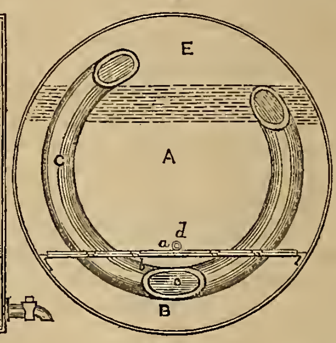


Fig. 2.

Fig. 1 is a vertical longitudinal section of a cylindrical steam-boiler, with the improvement; and Fig. 2 is an interior view of the back end of the boiler, showing the steam blow-tube as combined with the sediment chamber.

A is the water-chamber or space of the boiler, and E is the steam-space above the water-line. B is the sediment chamber. It is separated from the water-space by a perforated partition plate, *b*, of strong boiler-metal, which is fitted snug to the boiler all round its edges, and can only communicate with the water-space through the perforations or rows of holes punched in it. *a* is a broad plate, nearly as wide and long as the partition, *b*. It has the same number of perforations as *b;* and when the openings of both are directly above one another, there is free water communication through them between the water and sediment chambers. This is the way the plate *a* is set, when not blowing off, and during the time sediment may be falling down, as the water is evaporating in the boiler:—*d* is a rod attached to the plate *a*, which latter performs the office of a large slide-valve. This rod extends through the end of the boiler in a stuffing-box, and may be connected to the engine by chain or rod, or be operated by a hand-lever. C D is a curved sectional tube, with an opening, *c*, under the partition, *b*, with which it communicates. The top of one end of this tube is open in the steam-space, the other is a little below it in the water-space. By pushing in or drawing out the rod, *d*, so as to bring the openings of the valve, *a*, over the blank spaces in the partition, *b*, water communication will be cut off between A and B; and if the blow-off cock at the front end of the boiler be opened, it is evident that the steam will rush down the pipe, C, and force out all the water and sediment in chamber B, until the water-line is lowered to the lip of the arm, D, of the pipe, when steam will then rush down both branches. It is plain that no more than a certain amount of water can be blown out of a boiler to which this apparatus is attached, and it is equally plain that the sediment chamber will be swept out and cleansed. Whenever steam is seen to issue from the blow-off cock, it is closed, and the valve-plate, *a*, is pushed in or drawn out, as the case may be, so as to bring the perforations in both plates above one another.

New York. H.

STEAM-BOILER EXPLOSIONS.

We have this month to direct attention to an unwonted increase in the number of explosions of steam-boilers during the last few weeks. We give an illustration, representing the exact appearance of one of the boilers after the explosion which took place at Messrs. Adnit's Oil Mill, at Chiswick, on Monday, the 16th of July; and we have taken some pains to obtain correct details of this case, otherwise than by collating the generally incorrect reports of the newspaper press.

There has been one explosion of a locomotive at Camden Town, a week previously to the above, recorded in the "Times" of July 14th. Another locomotive burst on the 2nd July, on the South Yorkshire Railway, at the moment of its being detached from the train, by which the fireman is stated to have been blown high up into the air and killed. The explosion of the boiler of a steam-tug at Shields, called the *Witch*, is also mentioned in the daily papers of the 13th July. Besides the above, the Manchester papers give us reports of other explosions in that vicinity; one, at a wood-turner's, in Blackfriars-street, Salford, by which the stoker, *fifteen years of age*, was killed, and the boiler, 11 feet × 3 feet diameter, $\frac{3}{8}$ inch thick, was projected through several thick walls to a distance of 90 feet from its bed. The same paper, the "Manchester Times," of June the 16th, gives us an account of an explosion occurring two days previously, of remarkable importance, from the eminence of the engineers' names connected with it. It was one of the celebrated Nasmyth's *upright* boilers, 25 feet long by 5 feet diameter, on the premises of the no less eminent engineers, Messrs. Beyers, Peacock, and Co., of Gorton, near Manchester. This boiler contained an inside chimney-flue, *three feet in diameter*, made of $\frac{3}{8}$-inch plates, which *collapsed;* although it is stated that it was *calculated* to bear 100 lb. per square inch pressure, and was working at 65 lb. shortly before the explosion took place. If this statement is correct, it is perhaps fortunate for the gentlemen who made the "*calculation*" that no one was killed.

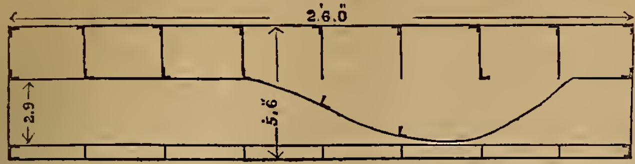
The marine-boiler referred to above was working at the now prevailing system of very high pressure, toward which we appear to be infallibly drifting, the certain consequence of bad trade and low prices for engineering work.

We have here, in as many weeks, examples of these deplorable accidents, as they are called, in each of the great departments of steam engineering—stationary, locomotive, and marine—calling loudly for a more adequate investigation than the subject has perhaps yet received. They have certainly been, happily, not attended with many casualties, or loss of life to so great an extent as frequently happens, and therefore cannot excite that great and painful interest in the public mind which we sometimes witness. This circumstance is, however, a reason rather in favour of than against a scientific discussion of the subject at the present time, inasmuch as the exact state of matters just previous to and at the moment of explosion can generally be ascertained to a greater nicety before than after fatal consequences have ensued. The parade of coroners' inquests, and the possible verdicts for manslaughter, are to a certain degree preventives of that fearlessness in witnesses imperatively necessary to elucidate any scientific truth, involved in such conflicting hypotheses as this subject confessedly is.

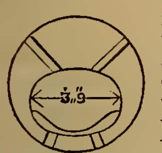
In the Chiswick explosion above referred to, we have, happily, a *living* engine-driver to testify to the fact of the explosion occurring at the very moment of his opening the stop-valve for starting the engine, instead of a *dead* man to be blamed by some eminent engineer for overloading the safety-valve.

Very many instances of explosions taking place at the time of starting the engine will occur to the readers of The Artizan, when one would naturally expect such a release to the confined steam would tend to diminish, rather than to increase, the pressure in the boiler.

Without adverting to the popular truism on all explosions—"the weakness of the boiler and the strength of the steam," and without speculating further on this Chiswick case at present, we may safely state that a slight inspection of our sketch will satisfy our engineering readers that the *oval shape* of the inside flue-tube, and the small quantity of water over it, have had a good deal to do with the explosion.



The boiler was made by Messrs. Wilson and Co., of Leeds, about three years ago. It is 5 feet 6 inches in diameter and 26 feet long, and originally had the furnace fixed underneath, but not giving sufficient steam it was altered within the last nine months, by having an oval furnace-tube, 3 ft. 9 in. × 2 ft. 9 in., with the furnace placed inside; the tube being stayed, as shown, through its whole length, by stays 4″ × ½″, which are now torn away from the rivets, and the top of the tube is collapsed and beat down within an inch of the bottom. The plates, for about 10 feet in length, over the furnace, are of Low-Moor iron. The safety-valve was loaded to the average pressure worked with (20 lb. on the inch) at the time the explosion took place, which was at about twenty minutes to one P.M., the workmen having just returned from dinner, and the engine-driver being in the act of opening the stop-valve to start the engine. It is considered fortunate by the proprietors that no loss of human life took place, although two horses were scalded to death.



THE RUSSIAN INFERNAL MACHINES.

The public mind has been excited, during the last month, by the accounts received of the vast numbers of these submarine engines of warfare which have been discovered, and the narrow escapes which several of the chief Naval Officers in the Baltic had of being killed whilst examining them.

Somehow or other, whatever accidents or misfortunes our Jack-tars meet with, in service or otherwise, they seem disposed to treat them amusingly. Their employment in the novel kind of *fishing* in which they have for some time past been engaged, in the neighbourhood of Cronstadt, has afforded them full scope in this respect, if we may judge by the amusing and interesting letters we have received from the Baltic.

Amongst the letters received from the Baltic Fleet during the month of July, we have been favoured, by a Naval Engineer friend, with a very correct sketch and description of one of these machines, as fished up by the crew of the steam-frigate to which he belongs, and we have much pleasure in being able to present it to our readers.

Figs. 1 and 2 illustrate these machines—Fig. 1 being a vertical section of the cone, and Fig. 2 a plan taken on the base, the cone being inverted.

The materials of which these machines are made are zinc in most instances, but galvanised sheet-iron in other cases. They are all conical in shape, about 16 inches in diameter at the base, and 20 inches long, and may be considered as divided into three compartments, viz., A, B, and C. When they are charged and prepared for submersion, they are made perfectly water-tight in the compartments A and B; and some of those found are, we hear, so contrived as to be water-tight in all three compartments, and yet allow of the sliding-rods, and contrivance for breaking the glass tube or phial, sliding freely, so as to ignite the fuse and explode the machine.

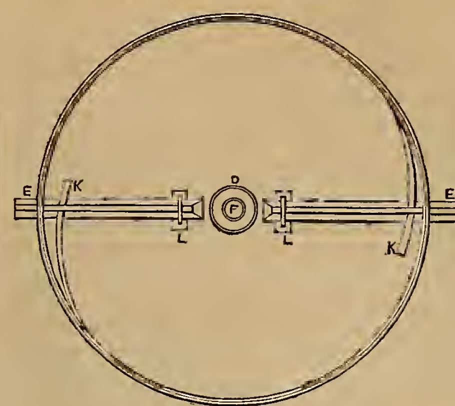
These machines are moored with the apex of the cone downward, at about 10 feet from the surface. The screwed eye-bolt which closes the opening in the apex of the cone, after the chamber A has been filled with from 8 to 10 lb. of gunpowder, has a brass ring attached thereto, and into which the mooring-line is rove: this mooring-line is attached to a grapnel in some cases, and in others it has attached to it pieces of granite, to sink the machine to the proper depth and keep it in its place.

A is the conical chamber, in which 8 to 10 lb. of gunpowder is filled through the aperture in the apex.

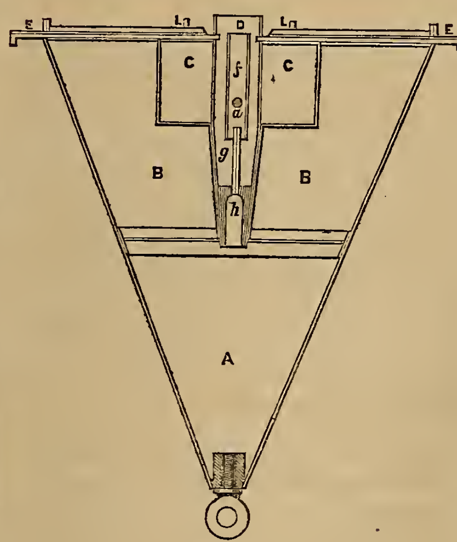
24

B B, the air-chamber for floating the machine. In the centre of this chamber, and communicating with the gunpowder contained in the compartment A, is the central tubular vessel, in which the fuse and apparatus for igniting it are contained.

RUSSIAN INFERNAL MACHINE.



Plan.



Section.

C C, the central chamber just spoken of, into which the water is admitted in some, and in others it is kept out, by an elastic but water-tight covering of india-rubber, which permits the rods for breaking the glass tube to play freely.

D, the tube containing a fuse, and, with a small brass tube, *f*, working inside on an axis, *a* (seen in Fig. 1), which is supported at the ends in the tube D. This tube, *f*, is moved out of the perpendicular, and swings on the axis, *a*, by the end of either of the horizontal rods, *e e*, coming in contact with it, and pressing it forcibly.

e e, two horizontal sliding-rods, long enough to project over the sides of the base plate of machine, as at Fig. 1; but the precise form and arrangement of these rods are best seen in plan at Fig. 2: they slide in guides, *l l*, as hereafter described.

f is the small brass tube as before described, mounted on a cross pin or axis, *a*, supported in the larger tube, D.

g, a case or tube of thin lead or tin-foil, lined inside with prepared cotton, and containing a glass capillary tube or phial, filled with sulphuric acid. This case or tube, *g*, is inserted in the upper part of the fuse, *h*.

h is the fuse which fills the opening at the bottom of the tube D, the opening thereof having been covered by a piece of waterproof but chemically-prepared paper being pasted, or otherwise fastened, on the inside of chamber A.

i, the eye-bolt screwed into opening at the apex of cone.

k k, two curved springs, to keep the sliding-rods in their proper places.

l l are guides, in which the two iron rods *e e* slide and are held ready for action.

The inner ends of the sliding-rods *e e* are bevilled for striking the upper end of the inner suspended tube, *f*; and the outer ends are turned down, to prevent its sliding in beyond the edge of the cover of machine.

When the machine is prepared and moored, it is ready for action, the *modus operandi* being as follows:—When a vessel comes in contact with either of the projecting rods *e e*, the inner end is driven forcibly against the upper end of the tube *f*, and moves it out of the vertical position, the lower end bending the thin leaden tube or tinfoil case, and breaking the glass tube or phial enclosed therein; the contents thereof (the sulphuric acid) immediately ignite the fuse, and the powder contained in the chamber A instantly explodes it with great violence.

These infernal machines, which until recently were looked upon as mere fancies or myths, have turned out not only realities, but such troublesome and numerous realities as to cause great excitement throughout the Baltic Fleet; for almost every square yard of the approaches to Cronstadt and adjacent forts is covered with them, although but few of them have exploded in the manner intended by the enemy. One of them exploded under the *Vulture* as she cast anchor a few days ago, and another as she was swinging to her cable. The first did considerable damage, breaking the crockery, and dislodging shot, &c., from the racks.

An accident occurred to Admiral Seymour and several officers, when examining one of these machines on the poop of the *Exmouth;* the Admiral having tapped the end of one of the projecting rods, when the machine exploded, burning and otherwise injuring all who were standing round it at the time. Several such cases have occurred; and it is to be hoped that greater precaution will be exercised in future, when these machines are under examination.

The *fishing* operation has been described as follows:—Two boats, having a long hawse-rope or whale-line attached to their sterns, separate, sinking the rope in 10 to 14 feet of water by weights attached thereto; the boats then row away together, and when the line comes in contact with any object beneath the surface, the floats attached to the rope for buoying it up and counteracting the weights attached to the sweep-rope immediately sink, as a fishing-float is known to indicate when an angler has a nibble or has caught a fish; the men in the boats then carefully haul up the sweeping-rope, and with it the object they have caught. This employment has been sought by the sailors as an amusement, and the results of these fishing expeditions have proved much more extensive than was contemplated or is commonly believed.

THE ALCOHOL DUTY.

Of all Government measures, those professedly destined for the advantage of science, whether in its abstract and speculative development, or in its commercial applications, are the most deplorably abortive. Here have all parties interested in the chemical arts been praying, year after year, for some measure which might enable us to compete with France and Germany in all the varied operations for which alcohol is necessary; and now we are greeted with an alteration in the law which is but adding insult to injury: alcohol may be obtained for manufacturing purposes, provided it be mingled with one-twelfth part of its bulk of methylic spirit! Have our law-makers ascertained that this contamination can occasion no inconvenience, no injury, in all the possible operations? What quality of chloroform, for instance, will be derived from this new mixture? We all know that this anesthetic *may* be prepared from wood spirit, but its quality is in that case decidedly inferior. Not a few of the accidents connected with the use of chloroform may be traced to this circumstance. But if the English manufacturer is for his sins condemned to use this new methylated alcohol, his product will, of course, be contaminated with those compounds which render methylic chloroform so dangerous. Again, wood spirit is far more commonly impure than is alcohol. The varied and complicated products of destructive distillation are not always removed, and alcohol, mixed with methylic spirit, is therefore a liquid of varying constitution and properties, and may often require a tedious and costly purification. The mixture may very possibly be useful to the varnish-maker, but we most earnestly protest against its being employed in the preparation of medicinal substances.

But this is not all: the reduced prices only come into operation if the quantity purchased exceed 100 gallons. To the analytical chemist the new measure will therefore be no relief: he will rarely find it practicable to store up one re-agent—and that, too, impure—in such overwhelming quantities, and must therefore continue to purchase at the old high rate, and to charge those who consult him in proportion. But so long as the fees for an accurate analysis are thus kept up by the high price of materials, so long will the merchant, the manufacturer, and the agriculturist prefer depending upon fallacious outward signs in the selection of samples, and will therefore be deceived. We hope that the chemical manufacturers of England will not rest until they get some more practical measure of relief—until unadulterated alcohol can be purchased free from any impost. As for the methylated mixture, we can only wish that the projectors of the law might be compelled to drink it.

NOTES BY A PRACTICAL CHEMIST.

Mr. Fox, of Sheffield, is in possession of a substance—whether natural or artificial does not yet appear—which will prove invaluable as a detergent, either as a substitute for or as an addition to soaps. Its action upon the human skin is all that can be desired, since it not only rapidly removes all stains, but leaves the cuticle smooth and glossy. For manufacturing purposes, the scouring of cloth, &c., it appears well adapted, as it cleanses the tissue without injuring the lustre of the surface.

Behaviour of Colouring Matters upon Earthenware under a Glaze of Lead and Borax.—The substances were laid upon biscuit-ware, and exposed to the usual heat of a glazing surface. Chromate of lime gave a yellow green; basic chromate of copper, a dark brownish red; chromate of iron, a dingy brown green; chromate of cobalt, a worthless bluish green; chromate of lead, a dingy yellow; proto-chromate of iron, a strong black. Common salt present in the earth of the sagger volatilises oxide of iron from the materials. If a piece of earthenware burnt red is furnished with a glaze, which though of good quality contains only 2 or 3 per cent. of common salt, the piece itself and all the ware in the neighbouring saggers will lose their glaze from the volatilisation of the lead as chloride. Nitrate or carbonate of soda makes the glaze flow still more readily. If a larger quantity of dry salt be placed in a sagger containing glazed earthenware printed with colours which are to appear after the fusion of the glazing, it is not injured, but the colours are changed. Cobalt colours are spread over the whole surface, giving an agreeable bluish tint to the white. In this manner flowing blue is produced. A trace of red lead added to the colour prevents too great volatilisation of the cobalt. Oxide of copper colours diffuse themselves with a greenish tinge. Upon colours derived from chrome and antimony, salt has no action. Nickel colours are diffused like those from cobalt.

Black Stain for Wood.—Runge's ink, formed by pouring two quarts of boiling water over one ounce of the commercial extract of logwood, and adding one drachm of yellow chromate of potash, is an excellent stain for wood. It is applied to the wood without warming, with a brush or sponge, the application being repeated three or four times. The price will not exceed 3d. per quart.

Adulteration of Oils.—The detection of oils obtained from the cruciferous vegetables, such as colza, rape, camelina, mustard, when mixed with other oils, has hitherto been a matter of some difficulty. The following test is proposed by Mailho:—25 to 35 grammes of the oil in question are boiled in a porcelain capsule, with two grammes of pure caustic potash (prepared with alcohol) dissolved in 20 grammes of distilled water. After boiling for a few minutes, it is thrown upon a filter previously moistened, and the alkaline liquor flowing from it is tested with paper impregnated with acetate of lead or nitrate of silver. A black stain, showing the presence of sulphur, indicates that one of the above oils has been added. A still more delicate method is to boil the mixture in a silver capsule, which will be blackened if one of the above oils be present even to the proportion of one per cent.

ANSWERS TO CORRESPONDENTS.

"E. G. Robson."—Sulphur is present in most kinds of animal matter to a considerable extent. It is most easily detected in an egg.

"T. S."—The conversion of grape-sugar into cane-sugar is an important desideratum, and involves nothing impracticable.

"Mercury."—The electric extraction of metals from the human system was first verified in the case of an electro-plater whose hands were seriously ulcerated by the absorption of metallic particles. The Paris cases in which this method has been employed for the extraction of mercury administered by unskilful practitioners are well attested. No shock is required, and the amount of electricity employed should be very moderate. Experiments in order to test the capabilities of the method are now in progress.

TRACTS ON STEAM.

By R. Armstrong, C.E.,

Author of the "Rudimentary Treatise on Steam Boilers," "Notes to Tredgold on the Steam Engine," &c. &c.

NO. 1.—INSTRUCTIONS TO STOKERS WORKING STEAM-ENGINE FURNACES CONSTRUCTED TO BURN THEIR OWN SMOKE.

1. First and foremost, stokers should understand that they are not to make a business of "stoking," but to leave it off entirely, excepting only when preparing to clear out the grate from clinkers and rubbish, which requires to be done generally three or four times a day with average qualities of coal; convenient times being chosen for the purpose, when there is least demand for steam.

2. A fireman's business is, first, to see, *before the fire-door is opened*, that no coal is left in the heap ready for going on bigger than a man's fist; and that very small coal or slack is wetted, or at least damp, as well as a little water always in the ash-pit. Then begin by *charging* into the farther end of the furnace, reaching to about one-third the length of the grate from the bridge, as rapidly as possible, from a dozen to twenty or thirty spadesful of coals, until they form a bank, reaching nearly, or quite, up to the top of the bridge; and then shut the fire-door, until the other fires, if there are any, are served in the same way.

3. In firing up, throw the coals over the rest of the grate, by scattering them evenly from side to side, but thinner at the front, near the dead plate, than at the middle or back. In this manner, keep the fuel moderately thick and level across the bars, but always thicker at the back than the front, *not by pushing the fire in*, but by *throwing* the coals on exactly where and when they are wanted.

4. Never for a moment leave any portion of the bars uncovered, which must be prevented by throwing or pitching a spadeful of coals right into any hollow or thin place that appears; and always remember that three or four spadesful thrown quickly, *one on the top of the other*, will make no more smoke than one, and generally less. But all depends upon doing it *quickly*; that being the main, if not the only point in which freedom from smoke and great economy of fuel agree; some firemen only putting on three spadesful, while another can put on four, and make 20 per cent. more steam in the same time by doing it.

5. In replenishing the fire, take every opportunity of keeping up the bank of fuel at the bridge, by recharging it, *one side at a time*. Whenever this bank is burnt entirely through, or low, and also when the fire is in a low state generally, take the rake and draw back the half-burnt fuel twelve or eighteen inches from the bridge, and recharge fresh coal into its place, upon the bare fire-bars, as at first.

An engine fire, tended in this way, will burn its own smoke without any difficulty, simply by admitting a moderate supply of air (which for safety to the boiler should be *heated*) at the bridge, this being a more certain and economical mode of prevention than that of *diluting* (not burning) the smoke by the admission of cold air at the fire-doors.

NO. 2.—INSTRUCTIONS TO STOKERS WORKING STEAM-ENGINE FURNACES NOT ESPECIALLY CONSTRUCTED TO PREVENT OR CONSUME THEIR OWN SMOKE.

1. Engineers and firemen who would keep steam with economy, should do with as little stoking or stirring of the fire as possible, if any. In order to do so, they should see, before starting, that the furnace is properly constructed for the purpose, and large enough for the quantity of steam required. The fire-grate should have about one square foot of effective fire-bar surface for each nominal horse-power of the engine, or for each cubic foot of water required to be boiled away per hour. The fire-bars may be from $\frac{1}{2}$ to $\frac{3}{4}$ inch thick on the face, with $\frac{5}{16}$ to $\frac{3}{8}$ inch draught spaces between them, and with joggles to keep them asunder nearly the whole depth of the bar. The boiler should have, at least, 9 or 10 square feet of heating surface per horse, and the chimney should be of sufficient capacity to create a draught into the furnace equal to the pressure of a column of water $\frac{3}{8}$ to $\frac{5}{8}$ inch deep, when the damper is set wide open.

2. In firing, spread the large and small coals (equally mixed) on all parts of the grate, thicker at the back of the grate near the bridge than at the front, because the draught is there the strongest, and the coals burn away quickest.

3. The fire should never be less than about 3 inches thick in the middle of its length, 2 inches in front, and 6 inches at the back of the grate. In no case should the fire exceed double the depth here stated; and never more than two-thirds of the fire-grate should be entirely covered with fresh coals at one time.

4. If a regularly uniform supply of steam is required, and the damper up, the quantity of fuel on the grate may be gradually increased; but when an increasing quantity of steam is wanted, the average thickness or quantity of fuel on the grate must not then be increased, but ought rather to be diminished, and supplied by smaller quantities at a time, and more frequently. So soon, however, as the supply of steam exceeds the demand, the coal must again be supplied by larger quantities at a time, regularly increasing the quantity of fuel on the grate, as before. On the other hand, when a diminished supply of steam is required, close the damper a little, and take the opportunity of levelling the fire or cleaning the fire-bars, doing one-half of the grate at a time.

A steam-engine furnace worked in this way will make very little smoke; or, if any, it may be prevented, when desirable, by opening the fire-door 2 or 3 inches for two or three minutes after each firing; bearing in mind that the production of steam is commonly lessened by doing so, but so is the consumption of fuel.

NO. 3.—SHORT ADVICE TO THE OWNERS OF STEAM-ENGINE CHIMNEYS RESPECTING THE SMOKE NUISANCE.

1. It may be set down as an axiom, that *a steam-engine chimney cannot be too large*, if only provided with a damper, although 99 in 100, at the present time, are decidedly too small. They are unable to create a sufficient draught of air through the furnace; consequently, a *smoky flame* is produced, instead of a flame with little or no smoke.

2. Want of chimney-draught is a defect which no smoke-consuming furnace in the world can remedy, whether using hot air or cold, unless by the application of an artificial blast, which commonly costs as much to work as the heat it creates is worth.

3. It being impossible to consume smoke without great heat, which requires a good draught, and difficult to get a good draught without a large chimney, I here set down a table of chimney proportions, which have been practically proved to answer well, with the inferior steam-coal of the manufacturing and midland districts, for many years past. It is true that somewhat smaller dimensions might serve, where the extravagant use of Newcastle coal is still continued, as in London; but even there, those dimensions and proportions ought to be adhered to, because of the constant tendency to increase the engine and boiler power, while the same brick chimney remains. For similar reasons, I commence with a chimney suitable for a ten-horse *boiler*, although a five, or even a two-horse *engine* only, may be required.

Height of chimney.	Inside diameter at top.	Nominal horse-power of boiler.
20 yards	1 foot 6 inches	10
25 „	1 „ 8 „	12
30 „	1 „ 10 „	16
33 „	2 feet 0 „	20
35 „	2 „ 6 „	30
40 „	3 „ 0 „	50
40 „	3 „ 6 „	70
40 „	4 „ 0 „	90
45 „	4 „ 6 „	120
50 „	5 „ 0 „	160
55 „	5 „ 6 „	200
60 „	6 „ 0 „	250

4. Before all things, remember not to *overload* the engine, nor *underpay* the stoker; or you will make the first a smoker, and the latter, if not already a smoker—something worse.

5. A common low-pressure condensing engine is usually overloaded when it has less than 25 circular inches in the cylinder for each nominal horse-power. And a high-pressure non-condensing engine ought to have from 10 to $12\frac{1}{2}$, and to be worked at double the effective pressure, at the least, of the former—say 30 to 40 lb. per square inch in the boiler.

6. As to the wages of stokers, it is their duty to get as much as they can, and most of them, in London, consider that they deserve 26s. to 36s. a week. The stokers of small high-pressure engines are usually worse paid than those of low-pressure; but it ought to be the reverse, because they incur more danger, and commonly perform the office of engineer as well. For example: suppose 36s. to be the proper wages for a stoker, I would give him 1s. more for *every pound pressure required above* 36, deducting that amount for every pound he allows the steam to rise above 50, which would tend to *prevent boiler explosions*; deducting also a similar sum for every pound the steam falls below 25 lbs. per square inch; and this last clause would go a long way towards preventing the nuisance of very black smoke.

NO. 4.—BOILER EXPLOSIONS.

1. The simplest, strongest, and safest boiler in the world, and the cheapest too, is the "Egg-ended Cylinder," if well made, kept clean, and not over-fired. Such a boiler cannot be well made and managed, in all respects, well fitted and well "set," if much less than 4 feet in diameter, by 10 to 15 feet long—say 5 to 15 horse-power, according to the size of the fire-grate; and it ought not to be larger than 5½ feet diameter, by 20 to 30 feet long—say 24 to 36 horse-power.

2. To prevent over-firing, a boiler should be supplied with *two dampers*—a boiler damper properly hung, with balance-weight in the fire-hole, and a chimney damper, the latter being free to open to a determined area of draught only, and *locked up.* Every boiler should be fitted up with a second, or a "*lock-up*" *safety-valve*, adjusted to blow off at 5 lb. per square inch higher pressure than the common one; and the latter should blow off at 5 lb. above the average working pressure by the steam-gauge. There ought to be *two steam-gauges:* one, the ordinary inverted syphon mercury gauge, having an *iron* steam-peg, attached directly to the boiler; and the other, a lock-up index-gauge for the engine-house. There must also be *two water-gauges:* one, the common glass-tube gauge, fixed as nearly as convenient to the steam-gauge, so that both can be seen at once; the other, an index-wheel gauge, fixed on the top of the front end of the boiler, with balance-weight and stone-float. Lastly, there should be two man-holes, one at each end, to afford facilities in ventilating the boiler when being cleaned or repaired.

3. The above-described boiler ought not to be *seated* in the brickwork, but *hung* upon cast-iron brackets, fixed 6 inches above the centre of the boiler, and 9 inches above the top of the side flues. If it is to be fired by hand, there should be *two* fire-grates and fire-chambers alongside each other, separated by a 9-inch wall of fire-brick, but joining into one at the bridge; and two separate fire-doors, so that, by alternate firing, the steam can be kept more uniformly, and, if need be, the black smoke may thereby be easily either prevented or consumed to the exclusion of any dangerous patent plan, of which there are many.

4. To keep a boiler in good order, it should be emptied and cleaned out regularly at the end of every week, unless it contains a mud-collector by which it can be cleaned out every day. If the water deposits a hard incrustation of the *sulphate* of lime, the boiler should also be scaled every second or third week, and in no case should that operation be deferred beyond a month. If the inside of the boiler be well rubbed over with black-lead and tallow after each clearing, the scale will be found to come off easier the next time.

5. The most important condition of all is, that every boiler, where practicable, should always have a never-failing supply of feed-water from an elevated cistern or enlarged feed-head, holding sufficient to serve the boiler for an hour or two, when the engine may at any time be standing, and the feed-pump not at work. Adjacent to the stand feed-pipe which supports or connects this feed-head to the boiler, there should be another stand-pipe, or *safety-pipe*, open at both ends, the lower one terminating within the boiler about 6 inches below the surface of the water. The length of this safety-pipe, or the vertical height at which the water within it will stand above the water-level in the boiler, may be estimated at the rate of 28 inches for each pound pressure of the steam, or 28 feet for 12 pounds per square inch.

6. A boiler made to either of the above dimensions, with good plates $\frac{3}{8}$ inch thick, ends $\frac{7}{16}$, may be worked with perfect safety up to 50 lb. per square inch; and, if fitted up with the safety-pipe, may defy the ingenuity of man to burst it with the fair pressure of steam, which can no more be done than a tea-kettle could be so burst while the spout remains open.

REVIEWS AND NOTICES OF BOOKS.

The Official Illustrated Guide to the London and North-Western Railway. By George Measom. Seventy beautiful Engravings. London: H. G. Collins, Paternoster-row.

This book belongs to that extensively-diffused family, created for the immediate amusement and instruction of railway travellers; in looking over the

pages of which, and admiring the illustrations, we could not help recalling the remark of Balzac, referring to the orthography of Polish proper names, in his *Etudes de Mœurs*,* in which he says that the vowels are surrounded and protected by massive consonant-works. Mr. Measom protects his letter-press by admirable sketches, certainly; and what his book lacks in descriptive writing is in a great measure supplied by pictorial description.

We do not say that the book fails in description, but that the illustrations are really very good. Mr. Measom has done us the honour of *re-arranging* and publishing, amongst other remarks on the town of Liverpool, *a part of* our description of the Mersey Forge; and, as an example of his engravings, we give the reader a representation of it, being enabled to do so by the courtesy of Mr. Measom and his publisher. Now, we have often protested against non-professional men writing on professional subjects. It can be no satisfaction to the public to read generalities, however picturesquely grouped, upon subjects which take years of study to appreciate and understand. To the professional public, we need not say, such remarks are very distasteful. For instance, what can any one make out of this *extract* from The Artizan? "It is useless to estimate the force of the forge-engines in horse-power—horse-power being varied to meet emergencies"! Why, of course, it is, in every application of the steam-engine; but the point to be noticed in the forge-engine is, that there is always a large amount of disposable heat from the furnaces, which can be used to increase the

* *La Comédie Humaine—Etudes de Mœurs.* "Qu'il soit permis d'écrire les noms comme ils se prononcent, pour épargner aux lecteurs l'aspect des fortifications de consonnes par lesquelles la langue slave protége ses voyelles, sans doute afin de ne pas les perdre, vu leur petit nombre."

pressure of steam in the boilers supplying the engine attached to the rolls, if necessary. Our remark is really as follows:—"It is useless to estimate the force of these forge-engines in horse-power: the strains upon the machinery are at times so sudden and severe, that all parts are made exceedingly strong; the pressure of steam is increased if the cylinder at some given pressure is not large enough for some given work, and so the horse-power is varied to meet emergencies." Again, we must beg to remark, that we did not say that there is nothing like the Mersey Forge in the kingdom: of course, this means, in point of excellence—indiscriminate laudation is either falsehood or blunder, equivalent, as the world goes, or rather equi-noxious to the character of the man who indulges in it, or the book wherein he prints it. There is *something like* it at Crewe; of which circumstance, by the way, Mr. Measom says not a word; though he says that there is a large establishment for building and keeping in repair the locomotives and carriages in use on the London and North-Western line north of Birmingham. Surely we may expect to see *some account* of the excellent works carried out by Mr. Talbot for the manufacture of the rails for permanent way at Crewe, in Mr. Measom's next edition. But this shows the difficulty that must always be encountered by a writer who describes technical or professional affairs. Good wine, says the proverb, requires no bush. Not absolutely, we grant—it may be found without; *yet* we defy any one to maintain that a good, handsome bush, well lighted up, would be an injudicious ornament on the outside of receptacle of said good wine: the Mersey Forge is a right good place—let it have its "bush!" but do not let us obscure it with a *forest* of praise that will attract at once the beasts of envy and detraction.

But to return to the book itself, as a guide—as a description of a great engineering work, the London and North-Western Railway, perhaps the greatest scientific and commercial undertaking of the present century, to the perfection of which the strongest minds and most enterprising men of the day have been employed. The writer, we are quite sure, is an experienced railway traveller; and many a traveller who has in vain tried to steady himself to work on that "third volume" or "last number of Thackeray's," with the aid of the comfortable elbows of the first-class carriage, or wedged himself up into the corner of the sterner second-class variety, will thank Mr. Measom for telling him that "the secret of reading in railway carriages—and the writer has studied several thousand pages while whirled along the iron way—is to prevent the communication of the vibrations of the carriages to the arms and book. The elbows should not, therefore, be rested on the solid parts of the carriage, but the book should be held in both hands and supported by muscular power; the full elasticity of the arms, from the shoulders downwards, acting like carriage-springs to the volume, while the head, by being balanced on the neck, or, at least, not pressed or rested against the solid sides of the compartment, is equally free from communicated vibration. When the traveller desires to see much of the country through which the line passes, he cannot do better than select for his conveyance a third-class or parliamentary train, to which first and second class carriages are always attached." If the traveller follows this advice, and also provides himself with such a lamp as is described on page 6, he will be able both to *see* and *read*; and thus these practical "experiences" of Mr. Measom will materially conduce to render a nocturnal journey less wearisome than it is usually found to be. We do not think that travelling by rail is a pleasant mode of seeing scenery: when you have just discovered a pleasant prospect, before you have time to make a note of it, the land of promise is shut out by a very fine indeed—embankment—a *chef-d'œuvre* of a "beast after its kind," as the tourist probably thinks. One certainly sees much from the windows of a railway carriage in a short time—so one may derive much support and nourishment from a Fortnum and Mason concentrated meat-lozenge. Of course, when the roast beef is not to be got, make the best of the disagreeable substitute; so, if you cannot drive through England on a fast coach, you must make the best of being *driven* through by one of those stolid Britons, with whose peculiarities Albert Smith has familiarised the public, at forty miles an hour. Any attempt to condense a description of 156 pages of a journey from London to Liverpool or Manchester is uncalled for: we must not find too much fault either with Mr. Measom for neglecting the Wolverton and Crewe workshops; though, personally, we should have been more gratified if he had spent a little more time, and devoted a little more space, to these great workshops than to the *grate* show-rooms of Alderman Bennett, of Liverpool, and Messrs. Pooley's weighing-machine manufactory.

Mr. Measom makes many significant remarks, which cannot fail to give rise to reflections on the journey which may profit "king, lord," and (as we do not live in Fielding's days) third-class passenger. For instance, in passing Bushey we are interested to find that the right of passage through the Park is at present undisputed—recovered by the exertions of an individual in humble life, whose name and calling we should like to see attached to the brief notice of him. Perhaps our obliging neighbour, who looks local, and "has no objection *whatever* to smoke," can tell us? "Exactly!" We immediately compare notes, and do not thank or bless the Earl of Essex, who forced upon the Company the necessity of Watford Tunnel, nearly a mile long. With the help of Mr. Measom's suggestive text, we hold entertaining discourse till our friend goes away to Aylesbury, hitherto celebrated for the 800,000 ducks it annually sends to London—at present being notable as returning to Parliament a gentleman who wishes to exterminate "quacks." We remain in our through-carriage, spite of the temptation offered on page 28 to run up the Oxford branch and see the High-street;—this illustration is very neat indeed, and would well repay the expenditure of steel plate and india paper;—and, leaving Mr. Measom behind, we come to Wolverton at once. About this place we have no engineering information *literis scriptis*—certainly, a view of the interior of the works—and but must admit that, on the principle of not doing a thing at all if not well done, the omission may be justified; though in the next edition—which the great demand there is for the "Guide" at present will, no doubt, soon render necessary—we should like to find a slight letter-press notice as an accompaniment to the clever engraving. Rugby Station and School, especially the latter, get better treated than usual. Warwick Castle, also, is placed well before the reader—he will have some difficulty in avoiding a collision with it; and any one who has time and means at his disposal, and neglects to avail himself of the opportunity of visiting Warwick, deserves "*to be sent to Coventry,*"—where we shortly arrive on the main line.

Mr. Measom having allowed Byron, Wordsworth, and Moore to enliven his pages, might have let Tennyson tell of

> "Godiva, wife to that grim Earl who ruled in Coventry."

He tells us, however, that the

> "One low churl, compact of thankless earth,"

alias Peeping Tom, that prurient little tailor, is represented by a figure at the corner of Hertford-street; also that "Every third year the act of Lady Godiva is commemorated, when a female is found willing to ride on a grey horse, wearing a tightly-fitting flesh-coloured dress, and her hair flowing." We should certainly, on such an occasion, be inclined to get the fire-engine ready, with the water "flowing," to greet this "female" who every third year so misrepresents the brave lady who

> "——— took the tax away,
> And built herself an everlasting name."

Turning over the pages, we come to the illustration of the great Central Station at Birmingham, which, of course, is an object of vast interest; and, with the help of the report by Mr. Phillips, part of which Mr. Measom quotes, the practical engineer may get a useful notion or two, whilst the porter is vociferating for the tickets, by examining the roof, the span of which is 212 feet in the greatest width. Gillott's steel pen manufactory must interest most users of that necessary; and another of Mr. Measom's beautiful engravings is devoted to reminding and impressing on the memory the outward appearance of it.

In passing through the black country of Dudley and Wolverhampton, Mr. Measom recommends a walk, and makes some excellent remarks upon the bearing and state of the miners. Be the calling what it may, "a man 's a man for a' that;" and not only in the coal-mines, but in the costly assembling-places of his land does man need sympathy, otherwise he brutalises. We regret that we cannot accompany Mr. Measom farther, but we certainly can assure the traveller that this book is a good companion: it is suggestive—it may be used as an *ice-breaker*; the plates—which we freely admit we admire more than the letter-press—are alone worth the money. Valuable "experiences" are related by one who understands the principles of comfortable and instructive railway travelling; even a certain—we hope not "precious" Betsey, chief waitress at the Stork Hotel, Liverpool, is recommended and warranted "very efficient." So that the stranger does not find—or, with valuable attention to Mr. Measom, need not find—his journey tedious, nor at the termination thereof need he be at a loss as to where to direct the expectant "Cab, sir!" to take him.

Railway Machinery. Parts XXVII. and XXVIII. By D. K. Clark. Blackie and Sons, London and Edinburgh.

THE concluding parts of this excellent work on railway machinery, plant, and apparatus, have just come to hand.

Mr. Clark has redeemed the promises made at the outset; and we freely confess that a better work of reference for railway men, and one containing more examples of such works, with every detail, has never issued from the press.

Exercises in Arithmetic for the use of Schools and Artizans, &c. (with Key). By Robert Rawson, Head Master of the Dockyard School, Portsmouth. London: Whittaker and Co. 1855.

MR. RAWSON has done practical service in the cause of education. The little volume before us is an original work in the right direction—*practical questions* and *practical examples for practical people.*

In his preface, which, by-the-bye, is the only really faulty part of the work, Mr. Ransom says—"The questions, consisting of nearly three thousand, are entirely new, and are arranged in convenient sections, with a view to facilitate the labour of the teacher as well as the student, who will be able to accomplish, at least, one section for every lesson. Instead of giving an appendix of miscellaneous questions at the end of the book, in imitation of several useful works on Arithmetic, I have adopted a different plan, which I conceive is attended with considerable advantage, and from which I have derived great assistance in my own experience. The plan to which I refer is this: the examples are arranged in sections, and each section contains a question from each rule, forming something like an examination paper for candidates, either for new situations or promotion. The selection of the questions in each section has been made with a view to test the knowledge of Arithmetic, and the facility of performing, accurately, its operations; and I feel certain, from my experience in examinations and teaching, that any one who can work correctly one of these sections in the space of three hours, need not be afraid of passing any arithmetical ordeal."

And he adds—"For the advantage of Artizans and others who may use this collection of questions for the purpose of preparing themselves to pass an examination, I have given a solution, in full, to every question in one of the sections, together with such explanations as they appeared to demand, in order to make the operations intelligible and suggestive to the solutions of similar questions in the remaining sections."

And we agree with him when he says—"I know that there is great difficulty in carrying out any uniform plan of imparting knowledge, and developing the tender powers of youthful minds, which are as varied in their capabilities, modes of thought, power of retention, conception, and reflection, as are the heights and depths of the surface of the earth on which we tread. Still, I cannot refrain from thinking, that in all the rules and illustrations intended for this purpose, there should be an evident anticipation of a future difficulty and a future progress. This, I fear, is too frequently lost sight of in the instruction of youth. For the sake of advancing too hastily the present progress of a young man, rules and explanations are not unfrequently enforced on his mind that are not only of no use whatever in his more advanced studies, but they are a positive drag which weighs heavily on him in the prosecution of inquiries either for self-gratification or the improvement of social position. Such, I conceive, is the present defective mode of teaching what is commonly called the Double Rule of Three. I hope that teachers will not deem it presumption, if I state that the old plan of teaching the Single and Double Rule of Three by rule should be entirely abolished, and the methods of ratios and proportions, which more recent and correct views of this interesting subject have brought to light, should be made more prominent and intelligible."

A list of works recommended to the student by Mr. Rawson concludes his preface; but, really, he must have hunted up all the works published within our memory to have given such a formidable list of works upon the various branches of the immediate sciences treated of. 'Tis said that "too many lovers do puzzle a maid;" but such an array of works must sorely puzzle the intelligent Artizan or the inquiring student.

There are a few errors and omissions not noted in the list of errata, which, by-the-bye, is already too large for an elementary work of this kind, and we hope to see shortly another edition of this excellent work, with a shorter preface, and otherwise purged.

Drawing and Perspective—in a Series of Progressive Lessons, with General Instructions. Edited and published by W. and R. Chambers, Edinburgh and London.
Isometrical Drawing Books. Nos. I. and II. By R. S. Burn. Price 2s. each Part.

We recommend this *series* to the *serious* attention of the directors of the studies of youth, as well as to the Artizan and the schoolboy, as they will find what they most want—good examples well drawn, and the text written in a style simple, though ample and explicit.

Mr. Burn's former efforts are very favourably known to some of our readers.

LIST OF NEW BOOKS, OR NEW EDITIONS OF BOOKS.

DELASSAUX (V.) and ELLIOTT (J.)—Street Architecture: a Series of Shop Fronts and Façades, characteristic of and adapted to different Branches of Commerce. By Victor Delassaux and John Elliott. Engraved on Steel by Philip Brannon. Folio, boards, 25s. (Weale.)

HAY (D. R.)—A Nomenclature of Colour, applicable to the Arts and Natural Sciences, to Manufactures, and General Utility. By D. R. Hay. 8vo, cloth, advanced to 63s. (Blackwood.)

HERVEY (LORD)—A Suggestion for supplying the Literary, Scientific, and Mechanics' Institutions of Great Britain and Ireland with Lecturers from the Universities. By Lord Arthur Hervey. 8vo, pp. 20, sewed, 1s. (Bell.)

HOCKIN (J. B.)—Practical Treatise on the Photographic Processes of Glass and Paper. By J. B. Hockin. 3rd edit., 12mo, pp. 68, sewed, 1s. (Author.)

LARDNER'S Museum of Science and Art. 3rd double volume, 12mo, pp. 412, cloth, 3s. 6d. (Walton.)

MOSELEY (H.)—The Mechanical Principles of Engineering and Architecture. By Henry Moseley. 2nd edit., 8vo, pp. 675, cloth, 24s. (Longman.)

PROUT'S Bridgewater Treatise on Chemistry, Meteorology, and the Function of Digestion. 4th edition, by Dr. J. W. Griffith. Post 8vo, pp. 419, coloured maps, cloth, 5s. (Bohn's Scientific Library.)

BURN (R. S.)—Drawing and Perspective: a Series of Progressive Lessons, with General Instructions. By R. Scott Burn. Isometrical Drawing, Books I. and II., oblong, sewed, each 2s. (Chambers' Educational Course.)

CHAMBERS (W.)—Improved Dwelling Houses for the Humbler and other Classes in Cities, based on the Scottish Dwelling-house System. Royal 8vo, pp. 16, plans and plates, 1s. 6d. (Chambers.)

CHEVREUL (M. E.)—The Principles of Harmony and Contrast of Colours, and their Application to the Arts; including Painting, Interior Decoration, Tapestries, Carpets, Mosaics, Coloured Glazing Paper, Staining, &c. &c. By M. E. Chevreul. Translated from the French by Charles Martel. 2nd edition, crown 8vo, pp. 425, cloth, 12s. 6d. (Longman.)

DAWSON (J. W.)—Acadian Geology: an Account of the Geological Structure and Mineral Resources of Nova Scotia, and Portions of the neighbouring Provinces of British America. By John William Dawson. 12mo (Edinburgh), pp. 400, cloth, 10s. (Simpkin.)

HAYES (E.) and CLIFFORD (C.)—How to Lower Ships' Boats: a Treatise on the Dangers and Defects of the System at present in use, and the Remedy; with Illustrations. By E. Hayes. Also a Description of an Improved Block, to be used for reducing and regulating Strain in lowering Heavy Bodies; with Diagrams. By C. Clifford. Royal 8vo, pp. 28, sewed, 1s. (Simpkin.)

*FOSTER.—First Principles of Chemistry. Illustrated by a Series of the most recently-discovered and brilliant Experiments known to the Science. Adapted especially for Classes. 12mo (New York), pp. 136; London, bound, 4s.

*GILLESPIE (W. M.)—A Treatise on Land Surveying, comprising the Theory developed from Five Elementary Principles, and the Practice with the Chain alone, the Compass, the Transit, the Theodolite, the Plane Table, &c. Illustrated by 400 Engravings and a Magnetic Chart. By W. M. Gillespie. 8vo (New York), pp. 464; half-bound, London, 10s. 6d.

*MOORE (F., Civil Engineer)—A Treatise on American Engineering. Illustrated by large and detailed Engravings. 1 vol. 4to (New York), pp. 44.

*MUNN (B.)—The Practical Land Drainer: a Treatise on Draining Land, in which the most approved Systems of Draining, and the Scientific Principles on which they depend, are explained, &c. By B. Munn. Fcap. 8vo, illustrated, London, cloth, 4s.

*** All preceded by an Asterisk (*) are New American Books.

CANALS AND RAILWAYS IN INDIA.*

By W. Bridges Adams.

In opening the discussion, Mr. Adams deprecated any exclusive leaning to canals or railways, other than for their respective advantages. It was desirable to enclose and cultivate India; and, for the purposes of cultivation, irrigable canals were desirable; but, for the purpose of civilisation, fast travelling was essential. To assert that no railway ought to be made where water transit exists in a similar direction, would be to determine on a great waste of very valuable time amongst the most intellectual members of the community—a process fatal to the general progress of the masses. In all times and ages, rapid transit—rapid as compared with the general movement of the community—has been found a necessity of government and progress. The ancient Peruvians, lacking the means of mechanical and animal locomotion, established a communication of human runners, at posts a few miles apart, in order to convey messages rapidly. Modern Indians are used as beasts of burden to convey their ruling classes at the rapid rate of four miles an hour, because they find it a necessity to travel faster than bullock-waggons, through districts where water transit exists not, and horses cannot be maintained. It might be said that people ought not to travel at a cost of cruelty, but they do, and they will, in failure of non-cruel methods; and amongst the national cruelties that have been abolished by the advent of railways, that of the cruelty to post-horses is not one of the least; a cruelty, be it remembered, not of the poor, but of the rich; a cruelty, not of the race-course or of the hunting-field, but of the road; a cruelty which the legislator, returning from his duties to his estate in the country, indulged in as prominently as other men, when giving an extra half-crown to the post-boy to induce him to give an extra spurring to the bleeding ribs of the jaded post-horse.

Fast travelling must be, to induce civilisation, even at the cost of stinted rations to the poor, who have to do the work at the outset, not destructive fast travelling for whims, but travelling as fast as can be accomplished without greatly enhanced cost.

A mechanical difference in the construction of the canal and the railway is this: the former must be a series of direct levels, with sudden drops, in the form of locks; whereas the latter may be a gradual incline. It is obvious that the incline does not increase the cost in making the line, whatever may be the case in working it. But locks and their maintenance do very seriously increase the cost both of making and working.

Canals belong to peculiar localities, such as Holland, where the water is in abundance, and it is almost needful to dig ditches to make dry land. In such districts a canal does not become a mischievous monopoly; but in England, which is by no means a dry climate, the canals were a monopoly, for there was only a given quantity of water, and it was all owned, and could not be increased by manufacture. That also might come to pass in India.

The railway came and beat down the monopoly. Iron is not limited, like water; and wherever a railway proprietary charge large fares upon an extravagant capital or a spendthrift working expenditure, there, infallibly, in due time, will parallel lines of rail be laid down. The only way in which a practical railway monopoly could be accomplished in England, would be to purchase two strips of land, east and west, and north and south, in the form of a cross, and charge black-mail to every one passing over it, as the barons did in the olden time, when there were no Acts of Parliament to make individual advantage give way to the public good.

Rivers, to be constant, must be dependent on some process of nature for storing up water. In Chilé and Peru, the Andes perform the office by storing up the snow; but the rivers are little more than a hundred miles in length. In the Upper Ganges, the Himalaya range performs the same office. Mont Blanc and other mountain regions supply the Rhone, which was formerly a navigable river all the year round, while the snows were sheltered beneath the pine forests, and melted gradually. The pine forests being cut down, the Rhone is now an alternate mountain torrent and a non-navigable stream during great part of the year. The proof of this is, that within a few years past Lyons has been subject to periodical inundations which have washed down dwellings and stores constructed of unburned bricks. It is obvious that such buildings would not have been erected if they had originally been in risk of melting down like barley-sugar. The large American lakes which are drained by the St. Lawrence, and to which the limestone range of Niagara forms a bar, are fed by the rains and melting snows; and it is stated that their depth is decreasing by the constant felling of timber to supply the numerous steamboats, which exposes the snow to melt, and the water to evaporate. In Ireland the great bogs form a kind of natural springs, from which the water gradually oozes to supply the rivers. Other rivers are supplied by mountain caverns with large inlets and small outlets. In countries of continuous rain, the rivers may be continuous without any of these resources.

Leaving the problematical question of navigable canals, we come to the question of irrigable canals. Of *their* value and permanent utility, if India is to make progress, there can be no doubt. Colonel Cotton cannot well overrate them in this particular. My own belief is that in proportion as irrigation extends, population will thicken, and that ultimately it will be found that the whole of the water can be advantageously absorbed to render the dry land fruitful. In hot countries, the roots of the plants appear to be the best absorbents. Rain is not favourable to ripening vegetation. But the process of irrigating land by open channels is a costly one. Along the channels there is a thick and tangled growth of weeds, requiring a constant expenditure of labour to keep down. In the beautiful plain of Valencia, in Spain, the whole water of the river falls short of the necessities of the cultivators, and leaves much good land useless, and generates a perennial strife amongst the peasantry, which rises into an occasional tumult, with loss of life, and has to be put down by the soldiery. There is a proverb about the water:—

> "Una mitad al cielo,
> Otra mitad al suelo."
>
> "One half to heaven,
> The other half to earth."

Probably, of all the water that springs from the mountain, one-third is absorbed by the sun, and another third by the porous channel, to grow weeds, while only one-third reaches the cultivated land.

In hot Spanish countries, with irrigation, it is customary to plant the acequias or irrigation channels with trees, to prevent evaporation. But there is yet wanting a cheap and efficient mode of conducting irrigation water

* Abstract of Paper read before the Royal Society of Arts.

under ground; and when that takes place, it will be the most valuable gift that modern science can bestow on India, saving human labour, and preventing the waste of water. The water must be filtered before it enters the channels, to prevent deposit; and the channels must be easily accessible, to clear out obstacles. If Colonel Cotton will set himself to work to solve this problem, he will be a still greater benefactor to India than he has yet been.

One chief objection that Colonel Cotton makes to railways is, that by their cost and outlay they will prevent the canalisation of the Indian rivers, which would be much cheaper per mile. Yet he says that navigable canals are insufficient, and proposes as an adjunct light railways, the cost of which he does not tell us, though he asserts that the ordinary lines will cost £10,000 per mile. Now, a railway consists essentially of permanent way and rolling stock. These are the two items which cannot be done without, any more than the bridges and levelling. All else, expensive stations, &c., is a question of choice. The permanent way and rolling stock will not exceed £3,400 per mile; and earthworks and bridges, at £1,600 more, would only make up £5,000 per mile. Horse railways, wholly of iron, to work into this as branches, could be constructed at between £500 and £600 per mile: and by a horse railway, I mean a very permanent horse railway, and not a toy—horse railways that can be laid down by unskilled Indian labourers, after being shown how the first pair of rails go together. I go still further. There are districts where even railways to track light waggons by hand would be desirable, as in Welsh slate-quarries; and they also should be constructed wholly of iron, for reasons obvious enough to those who have had to grub up thorny roots to boil their kettle.

I have for many years past been an advocate, in print and out of print, of light railways for steam-power, of horse railways, and of portable railways. In the "Times" of January, 1850, and in the "Spectator" of February, 1850, these plans will be found favourably reviewed.*

The question of railways might be nearly an exact science, but it is far from that yet. Railways divide into two branches—tram-ways, or trammel-ways, in which the guiding power is on the rail, and railways proper, in which the guide is on the wheel. A commoner division is that of steam locomotion and animal locomotion, the structure varying with the loads to be borne. The railway is better than the trammel-way, for several reasons, as it keeps clearer from dirt and obstacles, and engenders less friction. The mechanical principles which should govern the construction are the same in all cases.

As the object of a railway is to lessen the obstructions to the movement of rolling wheels, we may consider the rail and wheel as man and wife, not to be treated apart; for as a bad wife may make a miserable husband, so a bad wheel may spoil a rail, or *vice versâ*.

The first thing to desire in a railway is, that it should be as nearly as possible a horizontal plain, straight, and parallel between the rails.

Secondly. The rails should be virtually inflexible under the rolling loads. In making a girder bridge over a stream, it is necessary that the depth of the girder should bear such a proportion to the length and load, that it will not deflect in the opening. A rail is, or should be, a girder, likewise non-deflecting; and if the support below it be a yielding material, or solid discontinuous supports, the rail must be deep enough not to bend between the supports or upon the unfirm material, or the result will be a line constantly out of repair, needing what is called maintenance of way and increasing resistance to traction. The pressure ought to be equally distributed by the absence of flexure, and this can only be done by depth.

Thirdly. The rails should be laterally inflexible, or great friction will ensue by the rocking of the engine and carriages. They should be laterally straight, or a continuous sinuous movement will take place.

Fourthly. The junctions of the rails should be so arranged that, while allowing for expansion and contraction, the strength of resistance, both vertically and laterally, should be as great at all the joints as at the intermediate portions.

Fifthly. An efficient connexion should exist between the two opposite rails, to keep them parallel.

Sixthly. The surface of the rails beneath the wheels should be so hard and tough, that they will neither crush nor laminate beneath the rolling loads.

Seventhly. The bearing surface of the rails or supports on the ballast should be of such area that the rolling loads will not disturb it.

Eighthly. The height of the wheel surface above the bearing surface on the ballast should be the minimum, while the bearing surface is the maximum.

Ninthly. The rail should bed into the ground, to keep it steady laterally, and prevent rocking.

Tenthly. The depth of the rail below the bearing surface of the ground should be so much in excess of the rise above the ground as to constitute a suspensive principle, in opposition to the principle of a prop, which is the common mode of structure. Where only light loads are required, the prop plan may be used for convenience; but it is not the form of greatest permanence.

Eleventhly. In maintaining the line of way, care must be taken to provide good drainage for wet weather, and easy means of watering in dry weather.

The construction of any railway, great or small, and its mechanical fitness, may be tested by these rules. Various modes of construction may be used, but all should be firm without loose jolting; and though timber sleepers have their advantages, no doubt greater permanence may be attained by an iron structure. Cast-iron, if in sufficient masses, will do; but wrought-iron is the best: and, to absorb mischievous vibration, loose timber blocks, analogous to wood-paving, and not structural, may be applied as a portion of the ballast at a cheap rate.

(*To be continued.*)

* "A pamphlet just published, entitled the 'Iron Ways,' will be read with satisfaction by proprietors of railway shares, for its hopeful anticipations of what may be effected towards a restoration of profits by the adoption of light and frequent trains. It also contains a number of suggestions on the general development of traffic, which, in point of ingenuity and completeness, as well as in the faith they exhibit in the extent to which the public would avail themselves of increased facilities, resemble the original Post-office plans of Mr. Rowland Hill."—From the "Times," Jan. 25th, 1850, Money Article.

"Redemption of the Railway System.—The author shows how the railway world can be rescued from its difficulties, and how the extension of a more manageable railway system, by its minuter ramifications into the very farms, would reconcile farming with free trade, as it would make transit easy both for produce and locomotive farming apparatus, and would thus bring a full manufacturing power and activity into the heart of agriculture. But although the view is put forth by a practical man, its reasoning is so clear, and its method of attaining the proposed end is so direct, that railway folks will pronounce it unpractical."—From the "Spectator," Feb. 9th, 1850.

THE CARLISLE MEETING OF THE ROYAL AGRICULTURAL SOCIETY.*

The proceedings of the Royal Agricultural Society in the North of England were commenced at Carlisle, on Thursday, the 19th, by the partial opening of the show-ground to the public. The admission, however, was confined to the trial-yard, where experiments were made with various steam-engines, and other machinery of large dimensions, to afford the judges the opportunity of testing their respective merits.

Two days have already been occupied in the preparation and trial of fixed and portable steam-engines. There were seven fixed engines in the yard, all, with one exception, of eight horse-power, exhibited by Messrs. Barrett, Exall, and Andrewes, of Reading; Clayton, Shuttleworth, and Co., Lincoln; William Dray and Co., London; Ransome and Sims, Ipswich; J. Gray and Co., Uddingstone, Glasgow; Smith and Co., Glasgow; and Tuxford and Sons, Buxton. Messrs. Hornsby and Sons had likewise entered the lists, but were unable, from the press of business, to complete their engines in time for the trial.

The array of portable steam-engines, both as regards beauty of appearance and excellence of finish, was, perhaps, superior to anything that has yet been exhibited under the auspices of the Society. They were nine in number, and by the following makers:—Messrs. Clayton and Shuttleworth; Ransome and Sims; Croskill, of Beverley; Garrett and Son, Leiston; Tuxford and Sons; Lee, of Walsall; Barrett, Exall, and Andrewes; Hornsby, of Grantham; and Boydell and Glasier, of London, manufacturers of the "steam-horse," or traction engine. With these pieces of machinery, Usher's "steam-plough" may properly be classed.

The trial of the fixed engines is conducted in a somewhat imperfect manner. The peculiar quality of the coal supplied is such as to render it impossible to generate steam sufficient for the satisfactory working of the engines, which were several times brought to a stand-still in consequence. Under these circumstances, the result must necessarily be an imperfect one. With both the fixed and the portable engines the usual method observed by the Society was adopted in the trials—that of supplying to each engine 14 lb. of coal for each horse-power, with which they were to effect as large an amount of work as the capacity and the economical arrangement of the machine would permit upon the dynamometer or force-resister applied by the Society.

So far as the trials have at present gone, Messrs. Barrett, Exall, and Andrewes have done the most work, running two hours and one minute and a half with one hundred-weight of coal; but, from the bursting of the flexible steam-pipe, the engine of Messrs. Ransome and Sims was stopped in the midst, and the eventual result will, of course, be affected by the coming trials.

The experiments of the day closed with the performance of Messrs. Clayton and Shuttleworth's engine of an amount of work exceeding any before effected, namely, three hours and twenty-seven minutes, being an eight-horse engine, with one hundred-weight of coal. Much speculation was rife, even to the extent of betting, as to the result of the coming contest, when Messrs. Hornsby and Sons' engine, which has carried off the prize for many years past at the annual meetings of this Society, will be tried, and, apparently, with no want of confidence on their part.

And now a word for the eccentric locomotive, which excited as much curiosity, if not as much deep attention, as any other machine in the yard—we refer to Boydell's locomotive or steam traction engine. It is possessed of two $6\frac{1}{2}$-inch cylinders; the engine is very readily reversed, and one peculiarity and excellence of its arrangement is, that the dragging wheels—which are the hinder pair of the ordinary carriage-wheels—are driven, not by gear on the nave of the wheel as in former attempts at locomotive farm-engines, but by gearing it at the circumference of the wheel, thus rendering available the leverage of the spokes of the wheel. The great obstacle to the application of steam-power to ordinary farm purposes has hitherto been the difficulty of moving heavy engines on clayey or other stiff soils. This is obviated by the so-called "portable railway" which the wheels of Boydell's invention carry with them, consisting of a series of shoes, or short lengths of rail, on a broad sole, that by an ingenious arrangement revolve with the wheel outside its circumference, thus literally laying short lengths of rail by the motion of the wheels themselves, the rail always being slightly in advance of the wheel laying it, and of course being pulled up and passed down again to the front by each revolution. By a short projecting pole, with chains attached to a wheel, in all respects the same as the rudder-chains and wheel of a ship, the engine is steered and turned completely round, both quickly and in an incredibly small space. Much amusement was occasioned by the manner in which it plodded through the yard, at the rate of about four miles an hour, going over two three-inch planks laid upon each other without any apparent check to the progress of the engine, which was also run along the side of a steep embankment, throwing it considerably out of level, without at all deranging its machinery or in the least decreasing its efficiency. It is well known that the "portable railway" has for some time past been on trial at Woolwich, and the principle, we believe, has already been applied to the wheels of some heavy guns at the seat of war. At Woolwich the experiment was satisfactory, but Lord Panmure is awaiting the result of the trial of this engine at the present meeting of the Society before deciding upon any extensive application of the

* From a non-professional contemporary.

principle. Should it prove satisfactory, it will be the commencement of a new era in military engineering and the transport of ordnance. It is asserted that the machine, though 6 tons 10 cwt. in weight, is available upon any soft, uneven ground. We ourselves saw it tried upon ground but recently saturated with rain, and though at the time working with only 9 lb. or 10 lb. pressure of steam, the movement was very satisfactory, and the impression upon the grass scarcely perceptible. It is also asserted that it can draw 70 tons, or something like a dozen field-pieces, or drag as many ploughs through the soil at one and the same time. This, however, remains to be seen, and we shall be satisfied when we do see it. The ordinary speed is about four miles and three and a half miles an hour; but that can be increased if necessary. One apparent obstacle to its service on very heavy ground is, that the tank containing the water is placed so low that it would be liable to be damaged by any strong obstruction in uneven or rocky districts; but whatever be its merits or defects, the judges will decide.

With respect to the general show of implements, there is, as far as we have yet seen, nothing very new or extraordinary. The number of combined thrashing, shaking, and winnowing machines is on the increase, and several of them appear to be much in advance of previous years. The trial of these implements will be next commenced. Besides the portable machines, there are three sets of fixed barn-works for thrashing and fixing and weighing off corn ready for market: those of Messrs. Clayton and Shuttleworth, Garrett and Sons, and Ransome and Sims, appear to be the principal rivals.

The trials of the engines were, as heretofore, conducted under the immediate inspection of Mr. C. E. Amos, consulting engineer to the Society. The judges of the engines are Mr. J. V. Gooch, civil engineer, and engineer of the Eastern Counties Railway, and Mr. William Owen, of Rotherham.

INSTITUTION OF CIVIL ENGINEERS.

May 8, 1855.

The discussion was renewed on Mr. Barton's paper "On the Economic Distribution of Material in the Sides, or Vertical Portion, of Wrought-Iron Beams," by reading the following portion of the discussion of May 1st, relative to the tubular beams now constructing for the Victoria Bridge, over the St. Lawrence, which had been expressly omitted in the abstract of the proceedings of that meeting.

The weight of a tube for a span of 242 feet had been stated to be 484 tons, for a double line; and that if, for comparison, it was increased to what it would be for a similar span to the Boyne, or 264 feet, the weight would be 530 tons. Now, the Boyne beam, as actually completed, was only 386 tons. The difference had been attempted to be accounted for by the Boyne Bridge deriving strength from its being a continuous beam, whilst the "Victoria" tubes were to be independent, and also by the Canada tube being 30 per cent. stronger than the Boyne trellis. This explanation of the difference, it was contended, was not satisfactory, inasmuch as no such difference could arise from the fact of the continuity of the beams being calculated on; and that the calculation of 30 per cent. greater strength did not agree with the statement that the "Victoria" tubes were calculated to bear a maximum load of 1 ton per foot on each line, and with this to be strained to 5 tons per inch of tension, and 4 tons per inch of compression. These being exactly the conditions of the Boyne Bridge, the strain of 4½ tons originally calculated on for compression having been calculated with certain allowances for rivets, and for variation of points of inflexion beyond that which could occur, and which made the actual result some decimals of a ton under 4 tons per inch; so that there was no difference as to the strength of the top and the bottom. The question of the comparison in this case might be brought to a closer issue; and in examining the sides alone, where the effect of the beam being continuous did not alter the amount of material required, it would be seen that if the amount about to be used for the sides of the "Victoria" tube, of 242 feet span, was 173 tons against 91 tons in the Boyne Viaduct, and then that the portion was deducted for the additional 22 feet, no fairer comparison could be made than between this span of the Boyne Viaduct, as actually completed, and the newest design for a tube by the very best authority on the subject. It must be admitted that some strength might be derived from the additional weight thrown into the sides of these beams; but inasmuch as the amount of gain was not known, it was practically useless, and it was therefore preferable to save the amount of material, rather than to place it where it was only of doubtful advantage. Hence it might be contended that in a trellis construction it would not be required at all, and thus, in the case of the Boyne Bridge, the additional iron required to convert it into a plate structure similar to the "Victoria" tube would be 82 tons, being 90 per cent. above that which was used.

It was urged that this comparison between the Boyne continuous beams and the "Victoria" detached tubes must have arisen from a misunderstanding, and was not tenable, inasmuch as it had been expressly stated that the latter were constructed for only one line of rails, and in the comparative statement the weight had been doubled, with an adequate allowance for the extra length. This, of necessity, involved the weight of four sides; whereas in a structure intended for a double line of railway, the two existing sides would have been sufficiently strong, inasmuch as from practical considerations the thickness of metal in the sides, as now constructed, was, in parts, nearly double what was required by calculation: hence credit should be given, at least, for dispensing with the weight of one side, if not with that of two sides. The comparison, also, as to the effect of the continuity of the beam, was entirely erroneous. It was stated in the paper that by actual experiment the point of inflexion was 45 feet inwards from each point of bearing: thus, for estimating the tension and compression of the bottom and top webs, it should be based on a span of 174 feet in the Boyne beams, as compared with 243 in the "Victoria" tubes, which latter were all independent of each other. The total space covered by the centre and two side openings of the Boyne Bridge was 526 feet, and the total weight was 688 tons. For the sake of simplicity, this bridge might be considered as divided into three openings of 175 feet each, with a weight of metal of about 229 tons each. Assuming, therefore, 229 tons as due to a span of 175 feet on the trellis principle, the weight of a beam of that description, of equal strength for a span of 264 feet, would be about 510 tons,—a difference of only 19 tons as compared with the tubular principle, without taking into account the advantage of continuity in the Boyne structure, on the saving above alluded to in the sides, which might be effected in adopting the tubular principle for a double line of railway. But the comparison of two isolated instances of bridges was a very unsatisfactory mode of testing a mechanical principle. As, in the practical application, many circumstances must influence the engineer, and induce considerable apparent anomaly in his practice; still less, then, must it be possible to institute any valid comparison between the practice of any two engineers.

It was argued that it was absurd not to credit a principle with a saving, even although in practice engineers might, with a view to extra security, fix the proportions of the other parts independently of that consideration. In the case of the trellis and the "Warren" girders, the sides obviously only served to connect the top and bottom strains; and independently of this, as they were in no respect self-supporting, the material in the sides only added to the load on the bridge: whereas, in the tubular principle, the sides, in many cases, not only supported themselves, but added to the general strength of the bridge; and, therefore, whatever might be the amount of strain they could sustain, so much must be considered as added to the ultimate strength of the bridge, or credit be given for it, in abatement of the load. Now, the experiments made by Mr. Doyne had confirmed the theoretical conclusion that the metal in the sides of a tubular beam was doing half the duty the same amount of material would have performed if it was situated in the top or the bottom webs; and these experiments were shown to be made under circumstances precisely identical with the disposition of the material in tubular beams. Generally assuming that the weight of a tube might be divided into three equal portions, of which the sides constituted one portion, it followed from these premises that as the material in the vertical rib was actually performing one-fourth of the duty imposed upon the top and bottom webs, and, consequently, for the purposes of comparison with the trellis, and other principles, that the saving of one-fourth of the united weight of the top and bottom webs might be effected, still placing the bridges so constructed on an equality as regarded ultimate strength; but the one-fourth of the weight of the top and bottom obviously exceeded by 50 per cent. the saving alleged to be made by placing the trellis-bars at an angle of 45°.

As to the economical use of material, it was, however, urged that as only 10 per cent. of the total weight of a bridge was involved under these three systems of construction, it was practically immaterial what principle was adopted; but under the considerations of the quality of the bridge, it could not be denied that in stability, small amount of deflection, facility of execution, and general safety, the tubular principle stood pre-eminent.

The opinion advanced, that there was not any neutral axis or point where the particles were free from strains of extension and compression, was objected to; and it was argued that in the line dividing the forces of extension from those of compression, there must be a neutral line, point, or axis, having no strain, except that of the friction of the particles or resistance to flexure, as shown in the experiments made by Mr. W. H. Barlow.

The position, that beam-bridges were about to supersede all other systems of construction, was also demurred to; and it was contended that, while admitting the great talent displayed in the construction of the Conway and Britannia Bridges, tubular girders generally were examples of an imperfect system of carrying a railway over a large opening, and that they should only be adopted under peculiar circumstances.

It was contended that the greatest amount of strength was obtained with the least material either by an arch which acted by compression alone, or by a suspension-bridge which acted by tension alone.

A girder might be compared to an arch with a tie substituted for the abutments, as in the bow and string girder; thus adding a weight to the arch in order to form a substitute for the abutment; and this additional weight, in a large span, formed by far the greatest portion of the girder. Or a girder might be compared to a suspension-bridge without any back chains, the top metal being introduced, as in the case of the Chepstow Bridge, to receive the compression as a substitute for the back chains; thus adding to the weight of the girder to such an extent as to prohibit the use of girders for large spans.

The trellis and the "Warren" girders, as well as the tubular beams, were similar in their action, inasmuch as the forces of tension were balanced by an amount of metal to resist compression, which formed, with the sides, the greater weight of the girder; and for this reason it would require ten times more weight of metal than the chains in the Niagara Bridge to substitute a girder for a chain bridge of that span; and even with that amount of metal and strength the bridge would be so injured by its own weight, that there would be some doubt whether the constant strain would not destroy it.

It was argued that engineers in this country had too hastily condemned the chain-bridge for railway purposes. Bridges for ordinary roads were liable, from the movement of a crowd, to as trying strains as railway bridges; and by having a girder parapet to spread the weight of the engine, and a girder platform to resist the side strains of the wind, engines might safely be carried over very large spans, without imposing any undue strain per square inch on the chains.

It had been assumed, during the discussion of May 1st, that the idea of the movement amongst the particles between the top and the bottom webs giving rise to an infinite variety of strains, passing through every point of the vertical rib, both of compression and extension, was incorrect, because the beam, when deflected, had changed its form, and consequently the relative position of the particles was altered. This might have arisen in the argument from a point being selected at some distance from the vertical mid-section of the beam. If, however, attention was confined to any one point in the vertical line of mid-section, say at the upper point of the top web, it was clear that when deflection did take place, this point absolutely moved in depression only in the vertical line; but as every point in the lower web had moved to a greater distance from that vertical line, so it was clear that an infinite number of lines of extension had taken place. By a similar train of reasoning, selecting any point in the bottom web, and considering the movement taking place among the particles of the top web in compression, a similar variety of compressive strains would occur; each particle, therefore, undergoing simultaneously compression and extension. It was contended, therefore, that a beam could not be divided into two regions, one solely of compression and the other entirely of extension: hence, therefore, it seemed unreasonable to apply the term "neutral axis," as indicating a position in a beam, where portions of matter became practically useless.

As to the assumption of the trellis-work being increased until the bars formed a continuous plate, it was submitted that as no exact limit had been specified for the proximity of the trellis-bars, there could not be any impropriety in assuming, by way of illustration, that state of things, with the view of showing that in trellis-work every particle of material was only undergoing one description of strain, and, consequently, the strength of material was not so efficiently employed as in the side of a plate-beam, where it appeared incontestable that every particle was simultaneously performing two duties.

After recapitulating the leading features of the paper submitted to the Royal Society by Mr. W. H. Barlow, and which had been quoted from at the last meeting, it was argued that the actual position of the neutral axis being there established, the resistance of the outer fibre of a beam could be estimated from the weight required to break it when applied transversely. In cast-iron, the resistance at the outer fibre was 40,000 lbs., while the tensile strength was only 17,000 lbs. A bar broken by direct tensile strain was broken without flexure; whilst a bar broken by transverse strain must first be bent.

The experiments showed that of the 40,000 lbs. total resistance at the outer fibre, 23,000 lbs. was required to bend the beam, and 17,000 lbs. to overcome the tensile strength of the metal. In open girders the ultimate resistance was between 17,000 lbs. and 40,000 lbs., and it was found by experiment to increase as the ratio of the depth of metal to the total depth of the beam increased.

In an open girder in which the depth of the metal was half the depth of the beam, the resistance at the outer fibre was 28,000 lbs.; and the experiments traced the resistance gradually up to 40,000 lbs. in the solid beam.

In wrought-iron, the resistance to flexure was less in proportion to tensile strength than in cast-iron. Nevertheless, it was an important element of strength even in wrought-iron; the resistance at the outer fibres in a solid beam being 50 per cent. greater than in an open girder, depending for its strength solely on the resistance to extension and compression.

Mathematicians had applied the axiom *ut tensio sic vis* in the case of transverse strains in which continuous fibres were unequally strained, without considering the lateral action arising from the cohesion of the particles. This, it was argued, required modification.

In reply, it was observed that throughout the consideration of the subject the experimenter had evidently proceeded upon the assumption, that the strains in a beam were all horizontal, and that a point called the neutral axis must exist. This point was stated to have been ascertained by microscopic observation. It was admitted that these observations might have been faithfully taken; but it did not follow that there were not other strains than those which were supposed to act horizontally, and which might add very materially to the strength or rigidity of the beam: in short, it would appear that the best mode of rendering the microscope available for ascertaining the true directions and intensities of the strains brought into play, would be by describing a series of circles, so as to occupy the whole surface from the centre to both ends of a beam. This, it was contended, would be the most obvious mode of determining the force and direction of the various strains; for it was evident that in the direction where the strains were greatest, the diameters would be increased, and the circles would each assume an elliptical form, showing by the elongation and diminution of the diameters, the true amount and direction of the strains. This mode of investigating the subject had been for some time in contemplation, and some steps had already been taken towards its execution, and it was anticipated that in the course of the next session the results would be laid before the Institution.

It was contended that, in the experiments alluded to, the measurements made on beams with and without strain showed that there was a neutral axis as regarded position; but it was admitted that there was not any point exempt from strain, and that the neutral axis retained its position, not because of the strain there, but because of the antagonistic strains neutralising each other at that point.

The term "resistance to flexure" had been employed, because the resistance it represented did not arise without flexure, and it increased with the flexure. It was not asserted that this resistance acted in lines parallel to the length of the beam: on the contrary, it arose from the lateral action of the particles on each other when unequally strained, and therefore to a greater or less extent in every direction.

Drawings were exhibited of the bridge designed in 1850 by Captain Moorsom (M. Inst. C. E.), and for which he obtained the Engineering prize from the Prussian Government for the proposed great bridge intended to have been erected over the Rhine at Cologne.

The bridge was intended to have been on the lattice principle, and constructed of wrought-iron, with three openings, two of 600 feet span each, and one, an opening arch, of 100 feet span.

The total length of the beams was about 1,380 feet; and that of the bridge, from end to end of the arched approaches, was upwards of 2,000 feet. The width was to be 50 feet, and the soffits of the beams were to be 45 feet above the high-water line, and about 65 feet above the bottom of the river. The ultimate strength of the large beams, of 600 feet span, was calculated at 11,500 tons, distributed over the two. The quantity of metal in each of the large beams was 13,514 cubic feet of wrought-iron, or about 2,896 tons, being about 4·83 tons per running foot, for a width of 50 feet.

It was contended, that this trellis bridge would have been a more advantageous employment of the material than if disposed as tubular beams for the same span.

The rule for calculating the strength of cast-iron beams, given at the last meeting, was taken exception to, as not being so correct as the old rule, known as Professor Barlow's formula.

7,600 constant for cast iron,
× sectional area,
× 4 times the depth, } all in inches,
÷ the clear span,

gave the breaking weight on the centre in lbs. By this rule, the breaking weight of the beams, stated to have been 26 tons, would have been 47 tons.

In reply, it was stated that the rule referred to was in effect nearly the same as that which had been given previously; both would give nearly the same results, provided the top flange was sufficiently large to act as the fulcrum upon which the remainder of the beam must be broken in tension.

Another edition of the rule referred to was:—
Total area of beam,
× Depth from top of beam to centre of gravity of the section;
× Constant number of 25;
÷ Length of bearing (in inches) gave the breaking weight on the centre in tons when supported at each end. This rule was approximately correct, but would be found to give sometimes too low and at others too high a result; whereas the rule given at the last meeting would be found correct for all cases.

It was contended, in closing the discussion, that the question resolved itself entirely into the relative value of the vertical middle rib, whether of the trellis form, the "Warren" truss, or the plate-beam,—the top and the bottom remaining the same in all cases. Practically, the principal saving in using the trellis system must arise from the opportunity of employing merchant-bars instead of plates; and in the truss, in introducing a certain quantity of cast-iron: against which, independent of all other advantages, must be put the facility of construction and of being raised entire to its position possessed by the plate-beam.

As to the so-called neutral axis, if by that term was meant a portion of material not performing any duty, it must be admitted that though there might be a point of reduced action, yet that all the particles in a plate-beam were doing more or less duty at all times, and in that sense there was no neutral axis.

Many practical considerations induced the employment of the tubular plate-beams; and the result had shown, on all the occasions of their use, their peculiar efficiency, especially as they had chiefly been employed in situations where it would have been impracticable to have established the scaffolding indispensable for the construction of the trellis-beams: therefore, any attempt to draw comparisons between the systems failed in the essential point of identity of situation and circumstances.

CORRESPONDENCE.

ON MOUNTING ORDNANCE ON THE NON-RECOIL PRINCIPLE.

To the Editor of The Artizan.

Sir,—Without troubling you with a repetition of details respecting the proved efficacy of arming small craft on the non-recoil principle, I would beg leave to refer such of your readers as may be interested in this subject to the "United Service Journal" for the year 1829, part the 2nd, page 333, where it is shown that a flotilla of pleasure-vessels, armed on that principle by the late Brigadier-General Sir Samuel Bentham, encountered a superior flotilla of the enemy, supported by ships of the line, and took, burnt, or sunk *nine* of them.

This mode of arming has of late been frequently discussed in the "Journal of the Society of Arts," Mr. W. Bridges Adams taking therein a scientific part. This gentleman has shown that when the charge of gunpowder is inserted in the middle of a hollow tube, the explosion of the powder would act with equal force upon *both* ends of the tube. This reasoning goes to prove that recoil may be counteracted by causing a piece of ordnance to run up an inclined plane, or by the weight of the piece itself; but he considers that elasticity of the materials that support the gun is essential to the safety of the piece itself, and to its bed: hence, he infers that in the late Mr. Feamal's experiments with a long gun mounted non-recoil, but attached to wooden posts, had that piece been affixed to stone instead of wood, the effect would have been different. Sir Samuel Bentham seems to have attached the same idea as to the necessity of some elastic material; for in fitting ordnance non-recoil, he repeatedly speaks of no other recoil than that which results from the elasticity of the breeching; and, further, he supposed that the vessel itself might recoil in the water in which it floated, and hence he insists on the necessity of making experiments on ordnance afloat, instead of against a target fixed on shore. The celebrated engineer, Mr. W. Fairbairn, stated that, in his opinion, the trifling recoil of a vessel in the water could not produce any appreciable difference whatever.

The great authority in naval gunnery, Sir Howard Douglas, does not, in the last edition of his work, enter into the comparative advantages of fitting ordnance on the principle of recoil, or of non-recoil; though he does state (article 149), "when the recoil was entirely prevented, the velocity of the shot, as shown by the *éprouvette*, was unaltered." Sir Howard, however, goes on to say that some uncertainty must exist from the irregularity of recoil. It must here be observed, that supposing the *éprouvette* to be depended on, the notion entertained by many is a false one, as Sir Howard says, that by elevating a gun, the distance to which it carries a missile is increased. But, however this may be, it was not on that particular that Sir Samuel grounded his preference for non-recoil: his chief experience of the great advantages of that mode of fitting ordnance he repeatedly stated to have resulted from the cheapness of the carriage necessary; from the comparatively small number of men required to work the gun; from the frequency with which a non-recoil gun would be fired; from the certainty of its use in all weathers, whatever might be the inclination of the deck; from the small space occupied, &c.; as may be seen in his Naval Papers, No. 7.

As indicated in Sir Samuel's paper, the first improvement in naval armament which he endeavoured to introduce was the principle of non-recoil, arming upon it the six experimental vessels he was authorised to build in the year 1795. On board of the two sloops, the *Arrow* and the *Dart*, he instituted the fairest possible mode of comparing recoil with non-recoil, namely, that of fixing half the ordnance on recoil carriages, the other half on the principle of non-recoil: thus armed, these sloops were employed in actual war-service from the year 1796, and after some years' trial of the two modes, the Commanders of these sloops requested permission of the Admiralty to have *all* their guns mounted *non*-recoil, which was done accordingly. Much prejudice existed against non-recoil, but which by degrees wore away, especially in Captains who had the opportunity of witnessing the advantages of Sir Samuel's schooners on the coast of France. It was on that station that the late Sir Sydney Smith became impressed with the advantages of non-recoil: consequently, on his sailing for the Mediterranean, he caused his 68-pounders and all his other carronades to be taken from their ordinary carriages, and to be mounted non-recoil. Soon afterwards, he was entrusted with the defence of Acre; and there, for the protection of the place, he caused ordnance of several descriptions to be mounted non-recoil, both on the fortress and afloat. Sir Sydney's success is recorded in history, and the efficiency of the non-recoil system was laid before the Admiralty, 25th November, 1813. Mr. Bray's report not only records the efficacy of non-recoil, but further exemplifies that by its means small old craft may sustain the shock of a heavy armament. For the defence of the town-gates of Acre, Mr. Bray formed a floating battery, consisting of three old vessels, on which he mounted no less than five heavy pieces of artillery, namely, a 24-pounder long gun, a 42-pounder howitzer, a 32-pounder carronade, and two 68-pounder carronades. The long gun was fitted at an elevation of 50°; a severe trial, as Sir Howard Douglas has shown that the force engendered by recoil increases with the elevation of the piece. Nor was it from want of use that this battery was not "materially affected;" for, to use the words of the report, "an incessant fire was kept up during the siege, which lasted sixty days."

All of these guns were bedded on materials to a certain degree elastic, thereby confirming the opinion of Mr. Bridges Adams, that elasticity of the supporting matter is an indispensable quality.

By degrees, experience of non-recoil led to its more general introduction. The number of prizes taken by the *Netley* schooner, thus armed, attracted marked attention amongst naval men; so did the action of the *Milbrook* with the *Bellone*, the French vessel having been in fact a frigate armed with 36 guns, most of them long ones, and having had a crew of, it was believed, 300 men, whilst the *Milbrook* schooner was but of 160 tons burthen, was armed solely with 16 carronades non-recoil, and her complement of men was no more than 50, including commander, officers, and boys; yet the *Milbrook* protected her convoy, and defeated the *Bellone*. In this very brilliant affair the *Milbrook* did not lose a single man, and thus confuted an objection that has been started against non-recoil—namely, that this mode of loading ordnance endangers the men. The *Dart*, too, found evidently the advantages of non-recoil, when she dared to attack, and actually captured, the *Désirée*, a fine French frigate, whilst in the port of Dunkirk, together with four or five other frigates. The *Dart* and *Arrow* both of them distinguished themselves at Copenhagen, as did also one of the four schooners so armed. But it seems needless to fill the pages of The Artizan with other proofs of the success of vessels armed on the principle of non-recoil. It should, however, be added that many coasting-vessels were so armed by Sir Samuel, and were thus enabled to defend themselves against privateers without the addition of a single man to their usual crew.

By degrees, Naval Commanders solicited the Admiralty to permit their vessels to be armed non-recoil, and, at length, in the year 1804 that Board issued an order that all carronades should in future be mounted on that principle, under the immediate superintendence of the Inspector-General of Naval Works. Sir Samuel, in consequence, solicited the appointment at each dockyard of one superior officer to direct such armament, as also the aid of a Quarterman as a general superintendent. The Navy Board felt themselves offended, though, at their own suggestion, Sir Samuel had had the sole management of the new manufacturing establishment in Portsmouth Dockyard; and, in consequence, the Admiralty rescinded their previous order to confide the fitting of carronades to the Inspector-General. Shortly afterwards he was sent on a mission to Russia, and, of course, could take no further measure for the due fitting of ordnance on the principle of non-recoil.

Now, as vessels of the same class differ materially in many respects —such as the thickness of their sides, the height and dimensions of their ports—no model applicable to all could be furnished. Hence, even before Sir Samuel went to Russia, he had the mortification to see that on board some of the vessels fitted by the Navy Board, not a gun on the non-recoil principle could be discharged without setting fire to the vessel; and, it may be remarked, that it is probably owing to some such neglect that the principle of non-recoil has fallen into disrepute.

It has been remarked above that the fitting of non-recoil artillery is simple; but this does not imply that common precautions should not be observed: for instance, the breeching should be of a good kind of rope, and the cascabel rings should be open enough to admit of its passage through them without chafing; it should be passed through a strong part of the ship's side, and be supported by rounded bolsters, that it may not be cut by sharp edges, or injured by boats coming alongside the vessel. It is evident that neglect of such simple precautions may in future, as heretofore, suffice to discredit the principle of non-recoil.

The particulars that were given in The Artizan for this month of Captain Julius Roberts' mode of fitting sea-service mortars bear every appearance of being correct; and if so, it appears that he *does not* allow *perpendicular* recoil; for, as his upper plate of cast-iron on which the mortar rests is "bolted down through the india-rubber to the wood-work," it is necessarily upon those bolts that the strain on firing rests.

As to the overturning of mortars in the Crimea, I being perfectly ignorant as to the service of such ordnance on shore, it would be highly presumptuous in me to offer any opinion of the *cause* of their having turned "head-over-heels;" but it may be observed that such a defect was not formerly attributed to mortars in actual service on shore, and that certainly it did not take place during any of the engagements in which Sir Samuel employed them afloat.

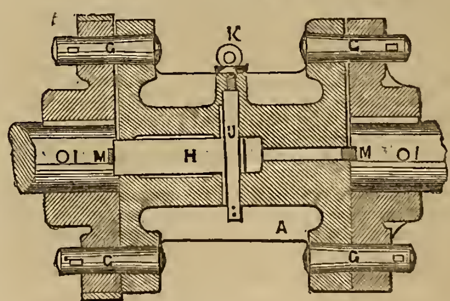
It cannot for a moment be supposed that I could arrogate to myself a knowledge of gunnery, but yet I hope I may be permitted merely to relate the opinions which the late General Bentham entertained on the subject, seeing that I possess his manuscripts as well as his publications, and that I was permitted to be present at most of his discussions relative to non-recoil, as also that I was a witness on several of the occasions when the commanders of vessels related the exploits they had been enabled to perform in consequence of their guns having been fixed on that principle. I am, Sir, your obedient servant,

Hampstead, 11*th July*, 1855. M. S. Bentham.

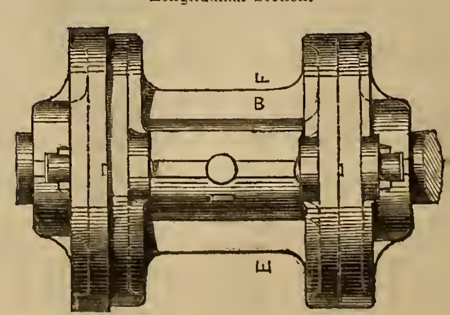
COUPLING SCREW-PROPELLER SHAFTS.

To the Editor of The Artizan.

Sir,—Enclosed I have sent you, for publication in your valuable Journal, a sketch of a simple plan for coupling screw-shafts to ½-in. scale.



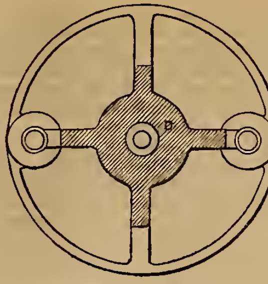
Longitudinal Section.



Plan.

A represents a section of intermediate distance-piece, which is intended to be placed between the engine and propeller-shaft; B, plan; C, end view of coupling bosses on propeller and engine shafts; D, section through (E, F); *g g g g*, pins for connecting it to bosses on propeller and engine shafts; *h*, pin fitted in the inside of intermediate distance-piece *loose*, the one end of which fits into a recess in end of propeller-shaft, for the purpose of keeping the surfaces apart when the propeller-shaft gets disconnected, to prevent friction that would be caused should the surfaces come in contact; *j*, cotter, for cottering up pin, *h*; *i i*, pins for preventing coupling bosses

End View.



Transverse Section.

from being drawn off when the engines are reversed, and also when the propeller-shaft is being drawn in, which will have to be done by two long screwed bolts and nuts for that purpose, which are not shown; *k*, eye-bolt for lifting out intermediate distance-piece; *l*, friction-strap for holding or preventing the propeller from revolving whilst being connected or disconnected; *m m*, pins to prevent the engineers from making a mistake in putting the intermediate distance-piece into its place: these pins are intended to be fitted into grooves, cut in the front surfaces of connecting bosses, extending from edge to centre, as shown; by that means it can enter but one way.

It is my opinion that if this plan were introduced in the mercantile screw-steamers, it would be the means of saving much time and expense in connecting and disconnecting screw-shafts, and prevent injury to the bearings.

Rostock. T. M.

SCREW-STEAMER "LIGHTNING."

Dimensions.	ft. tenths.
Length on deck	210 0
Breadth of beam	27 0
Depth of hold to spar-deck ...	22 6
Tonnage.	Tons.
Register, N. M.	682

Kind of engines, overhead, direct-action; ditto boilers, two tubular; diameter of cylinders, 43 inches; length of stroke, 3 feet; diameter of screw, 13 feet 6 inches; depth of ditto (or pitch of screw), 30 feet; number of ditto (or blades of screw), three; number of boilers, two; load on safety-valve in lbs. per square inch, 18; gross indicated power, 650; heating surface in tube, 2,400; draft forward, 8 feet 6 inches; ditto aft, 13 feet 6 inches; average revolutions, 55 feet; speed in knots with and against tide, average 14½ feet. Masts, 180 feet from deck to royal mast-head. Rig, brig, full rig. Classed at Lloyd's, 12 years, A 1.

This vessel is another proof of the rapid progress now making in the building and fitting of iron screw-steamers, and the marked improvement in speed attained by the screw, when properly applied, above that attained by the paddle-wheel. On her trial-trip, the engines made 55 revolutions per minute with 18 lbs. steam, driving a propeller 13 feet 6 inches diameter and 30 feet pitch. The speed of the vessel was 16½ miles per hour, being the greatest speed yet attained by a vessel of her class and rate of power, as she has only 1 nominal H.P. to 6 tons, with one boiler, and steam-throttled, so that 12 lbs. is kept in boiler. The engines make 45 revolutions; and then, with the aid of her sails, she steamed at the rate of 13 knots per hour on her voyage down the Irish Channel, previous to the pilot leaving her, with a consumption of about 8 cwt. of coal per hour. At this period the vessel had above 600 tons weight in her, and was very deep, drawing 16 feet water aft, and 13 feet forward. This we believe to be the best result yet attained from the screw, and we would try to analyse the cause of this for the general benefit of our readers. From her dimensions being, length between perpendiculars 192 feet, beam 27 feet, and depth 22 feet 6 inches, we have no great departure from the usual rule of seven times the breadth for length; and the ship being deep, does not give what would usually be considered a favourable form for speed. Her engines, 43-inch cylinder and 3 feet stroke, are not an extra size for such a vessel. The pressure she is worked at is not so great as that used by Penn and other engineers in the Government steamers, and those of the great steam companies. We are, therefore, constrained to look for the cause of this result in the harmony of the vessel, power, and mode of applying that power to each other. In the first place, the vessel is very hollow in her water-line, is what is technically called long-heeled, has good rise of floor, and is altogether a well-balanced body; the engines are the ordinary length of stroke for a similar size as applied to the paddle-wheel, and therefore give out the power to the vessel without that amount of friction and loss attendant upon short-stroke engines. She is powerfully rigged, and able to use the wind with effect, and has her propeller fitted abaft the rudder (as Beattie's patent), which enables the long-stroked engines to be used with proper effect upon a propeller 13 feet 6 inches, and 30 feet pitch. All these causes combined, conduce to the general result of great speed with absolute ease of motion, it being impossible to detect the vessel's being in motion by tremor either from engine or propeller.

She was built by the Messrs. Henderson and Son, of Renfrew; machinery made by the Messrs. M'Nab and Clark, of Greenock; and is now on her voyage to Calcutta, where she will be employed by her owners, Messrs. Apcar and Co., in the China trade. She was designed by Mr. John Dudgeon, of Fenchurch-street, London, and built under the superintendence of Captain R. B. Durham, part-owner, and well known in the China trade.

MEMOIR OF MR. WILLIAM DENNY.

Mr. William Denny, Iron Shipbuilder, Dumbarton, died suddenly, after a short illness, on the 1st of July, 1854, aged 39 years. Mr. Denny was born in the town of Dumbarton, on the 6th of June, 1815, and was the fourth son of the late William Denny, Esq., who carried on shipbuilding for upwards of twenty-one years in the same premises which were occupied by the deceased and two of his brothers. He commenced work with his father, at an early age, as a joiner; subsequently he worked as a carpenter; and, after mastering these trades, took a voyage to the East Indies, with the view of extending his knowledge of maritime affairs. On his return, he directed his whole time and attention to that branch of the business for which he seems to have been peculiarly qualified, viz., drafting or modelling, and in a short time had acquired remarkable proficiency in the art, as is shown by the fact that before he had attained the age of twenty, he was appointed Modeller to the British Association; while his models were in great repute among the shipbuilders on the Clyde and elsewhere, and eagerly sought after.

In order to make himself completely master of his profession, he proceeded to the United States of America; after making the tour of which he returned home, and in the year 1845 he and his brothers commenced business in Dumbarton as iron shipbuilders, and launched their first vessel that same year, viz., the *Loch Lomond* (for particulars of which see The Artizan, Vol. 1849, p. 244), and which was the first iron vessel built in Dumbarton; and, by skill, industry, and perseverance, they soon succeeded in acquiring a large trade, which has rapidly increased year by year, until their name and their fame have spread over the globe, and secured for Dumbarton and the shipbuilding of the port a proud distinction among the maritime towns of the world. Mr. Denny enjoyed a reputation beyond that of most men for his mechanical abilities and scientific acquirements. The vessels built by the firm of which he was the head, viz., Messrs. William Denny and Brothers (late Denny, Brothers), are well known for their beauty, symmetry, and gracefulness, and justly gained for him a name long to be remembered in connexion with the history of steam navigation and shipbuilding. And, withal, no man could be more free from vanity and ostentation. He did his work with the mind and the hand of a master; and after it was finished, and proved to be all that could be desired, he felt satisfied, but said nothing. Mr. Denny took every opportunity in his power of improving the town, having bought a steam-dredge to deepen the river, and improve the same by altering the embankments, &c.; and was the owner and promoter of Dennytown, a beautiful range of houses for workmen, built in the cottage style of architecture, two stories in height, having washing-houses and other conveniences connected therewith: it has a beautiful appearance, and is divided into streets and squares, &c. At the foot of William-street, on the corner of one of the houses, is the following inscription, viz.:—

Dennytown.

Built for the comfort and accommodation of the Workmen in the employment of William Denny. Founded 20th May, 1853, and completed in 18 months. 1854.

Mr. Denny took no active part in public affairs, and consequently came little into contact with society in its more antagonistic movements. His inclination lay more for retirement and study, in which he spent the greater part of his time not directly employed in superintending the operations in the building-yard. He was far from being unsocial, however, and enjoyed the favour of a large circle of friends and acquaintances, who will long cherish his memory with delight, and dwell upon his many excellent qualities with pleasure and satisfaction. It would be difficult to find a more warm-hearted friend, a more upright and honourable man of business, a kinder employer, or one more enterprising in spirit. He was buried in the new cemetery of the town (which is very remarkable, from the circumstance of his being the promoter of the new burial-ground, and the first individual interred therein) on the 5th of July. Borne on the shoulders of the workmen, and followed by his relatives and the town council, two thousand persons lined the streets to view the funeral procession, and show respect to the memory of the deceased. Mr. Denny has left a widow and four children to mourn his loss.

Mr. William Denny, the father of the above, died in December, 1833, aged 54 years. The first steamer in Dumbarton was built by him, which of course was of timber, viz., the *Trusty*, launched in February, 1814; also the *Margery*, launched in June of the same year,—the first steamer that went to London, and the first that plied on the Thames—in November, 1814; she then went to France, and afterwards crossed the Atlantic, being the first steamer that did so, but under canvas. In May, 1815, he launched the *Greenock*, No. 1,—the first steamer that went from the Clyde to Liverpool, where she remained, and plied on the Mersey. In April, 1816, he launched the *Rothesay Castle*, the first of the celebrated line of "Castle" steamers so long well known on the Clyde; and in the same month and year he launched the *Wellington*—the steamer that plied regularly between Dumbarton and Glasgow, the pioneer steamer of the company, which is now the oldest steamboat company in the world. In May, 1818, he launched the *Rob Roy*, which was the first vessel that plied between Glasgow and Belfast; she went to Dover, in 1820, and plied from that port to Calais, being the first vessel that united Scotland to Ireland, as also England to France, by steam power: she was afterwards sold to a French company, who lengthened her, and named her the *Duc d'Orléans*. W. F. Brock.

RECENT AMERICAN INVENTIONS.

An Apparatus for supplying Steam Boilers, patented by Mr. Benjamin Bee, of New York.—Figs. 1 and 2 are sectional views of this apparatus, showing the internal arrangements and the different positions the two valves are made to occupy, by which contrivance water is supplied to the boiler in proportion to the demand. A is a rectangular box bolted upon any convenient part of the boiler, and at such height as its centre shall correspond with the proper water-level; this box is divided by a partition vertically into two parts, and at the back, next to the boiler, is the upright valve, *o'*. *c c c*, Fig. 2, are posts in this partition corresponding to others in the valve, which afford free communication between the chest and the boiler. *d* represents a valve lying horizontally against the upper surface of the box, corresponding to the ports *f* and *d*, which communicate with pipes leading to the tank wherefrom water is supplied. *r* and *r'* are the valve-stems respectively, which are actuated by a rocking shaft and lever. It is made to vibrate about 90°, and from four to six strokes per minute, by suitable connexion with any positive mover. When one of the valves is shut, the other is open, and *vice versâ*.

Fig. 1.

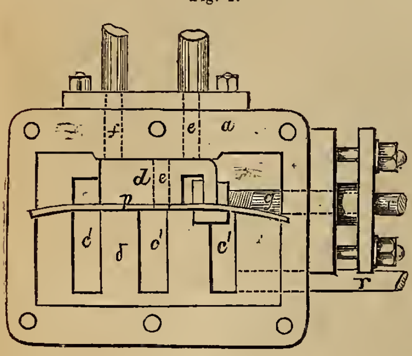
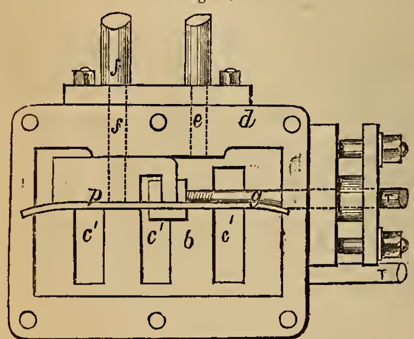


Fig. 2.



Having designated the principal parts, we will consider their operation. Suppose the water to be at its proper height in the boiler, and the ports, *c c c*, Fig. 3, being open; its level will be continued through each section of the box, and will stand as represented at *b*. It is evident, then, that the lower half of the box will contain water, and the upper half steam. If, now, the lever, P, be carried to the right, the ports *c c c* will be closed, and all communication with the boiler shut off. By continuing this motion of the lever still further, the valve *d*, which had remained stationary, as in Fig. 2, will assume the position as in Fig. 1. It will be seen by this Fig., that the port *e* commences at the valve-seat, while the port *f* is continued through the depth of the valve. The effect of this arrangement is, that whatever steam the box contained naturally seeks *e* as its outlet, and is conveyed to the upper part of the tank by its appropriate pipe, while at the same time water is flowing from the tank through pipe *f*, and the box or sheet is immediately filled with water. In due time the lever, P, returns, the valve *d* assumes a position as in Fig. 2, the ports *c c c* are opened, presenting the water in the box one-half its height higher than in the boiler, which, however, immediately finds its level by flowing into the boiler, being replaced by steam. By the next change of the valves, the box is again filled, then again emptied, and so on. It will be seen that by this apparatus the level of the water in the boiler cannot supersede a certain height. Suppose, for instance, the consumption of water to be checked, this machine being in constant operation, the water will begin to rise into the boiler, and each feed introduced will be proportionably less, until the level of the water in the boiler arrives at the upper surface of the box, where the feed will stop, because the chest or box cannot receive any more. And when the valves change for water to pass to the boiler, it cannot do so, it being already on a level. So, also, should the water fall in the boiler, such feed will be proportionably greater, until the whole boxful is discharged at each stroke, which is calculated to be ample for all emergencies.

This apparatus is especially adapted to stationary engines where a tank or heater is employed, or where the water is received at a higher level than the boiler. It does not add materially to the cost of such an engine, as it supersedes the necessity of a force-pump. For all steam generators where steam is not employed as a motive power, its adaptation is evident.

LIGHTNING CONDUCTORS.

The recent severe thunderstorms which have visited not only the Metropolis, but the entire area of Great Britain, have damaged many fine buildings. As usual, the churches have suffered severely; but chimney-shafts and other high buildings have come in for their share of damage. Why are lightning-conductors not more extensively applied? They are cheap enough; efficient copper conductors can be had for a few pence per foot, fitted complete.

Copper-wire rope conductors are the most easily applied, and, when judiciously set up, are the most efficient and cheap kind of lightning-conductor we have ever seen successfully used, either for ships or buildings.

For the application of copper-wire rope, as a substitute for the more expensive, and, possibly, less effective modes of protecting ships from lightning, we believe we are indebted to the late Surveyor of the Navy, Sir William Symonds, his chief assistant Mr. John Edye, and Mr. Andrew Smith, the inventor and original patentee of wire-ropes. These gentlemen submitted their plan to the Admiralty, who directed it to be tried, and, when fully tested, it was ordered by their Lordships to be adopted in the Royal Navy.

Sir W. Snow Harris has spent many years in advocating the necessity for protecting ships and buildings from the effects of disruptive discharges of electricity, and, labouring in the cause of science and of humanity, has reaped those rewards to which he has entitled himself at the hands of the Crown and the nation's advisers—honours and pecuniary grants.

In the Royal Navy, most of the vessels are fitted with "Harris's" copper-plate conductors, which are let into the masts. Many public buildings, monuments, &c., are similarly fitted, and for such purposes, where a national exchequer pays for such works, permanent applications of the kind described are, perhaps, the best suited; but, for general commercial use, a less costly, though not the less efficient, kind of protection is desirable. And such, our experience induces us to state, is found in the copper-wire rope made by the patentees.

When copper rope is made from stout wire, drawn from *pure copper* rods, and laid up without hempen cores, it will last for many years sound and reliable; but we fear that not alone do the makers use copper alloyed with zinc, which soon perishes, but we know that they do too often sacrifice the lasting properties of the copper-rope conductors, for the neatness of appearance, by using too fine wire, which aggravates the evil caused by the use of alloyed copper.

There is another point to which we must here call attention, viz., the careless manner in which these copper-rope conductors are applied. Often are they stuck up in the most inefficient positions—carried down and along a building in the manner least calculated to give perfect protection, although most calculated to tell in favour of quantity (at per foot) and cost. Few are properly fitted; and, in nine out of ten cases, neither the true principles upon which conductors should be applied, nor the local circumstances, are properly understood. Why should this continue?

Now that efficient lightning-conductors can be obtained at so small a cost as to be quite within the means of every private house-owner, it is much to be regretted that those living in isolated and exposed situations do not provide themselves with such protection. Churchwardens should be held personally responsible for damage by lightning caused by the omission of such precautions, as also for not insuring the sacred edifices under their wardenships. This would soon have a salutary effect, and we should hear but seldom or never of churches being damaged by lightning.

During the latter part of July we have been visited severely. At Epsom, and along the Croydon and Epsom Railway, we have noticed several cases of damage; and on Saturday, the 14th inst., one of the pinnacles of the Church of the Holy Trinity, Brompton, was struck, and entirely destroyed; in St. John's Wood, at Highgate, and elsewhere around London, several houses were injured; and we learn by the newspapers, that the Church of St. Ebbes was injured, the lightning having struck the tower, split some of the stonework, passed from thence through the roof of the church on its way to the earth, and melted part of the spouting, which must have been old and much oxidised. Curiously enough, the lightning appears to have struck the pulpit, and detached the door from its hinges.

In the Midland Counties, North Wales, and the West of England, the storm appears to have been very violent. At Bristol the storm exceeded in violence anything that has been known in that city for fifty years past: the thunder was very violent, and the lightning so vivid, that the Captains of African and Indian ships in that port describe it as being the nearest approach to a tropical tornado that they ever witnessed.

THE STATE OF THE THAMES.

The attention of the public and authorities having been recently directed to this subject by the able letter of Professor Faraday published in the "Times," it is hoped something will now be done to cleanse the river, or at least prevent its further pollution. Various as have been the schemes proposed—and some of them are practical and simple enough—somehow or other, the Commissioners of Sewers seem to have hitherto neglected to take any steps to abate the nuisance; and although they have expended enormous sums of money, it has not been in concert, nor with a view to carry out any general system of drainage by which the sewage on both sides of the Thames would be intercepted, and the pollution of the river avoided.

The value of the sewage matter so wasted, and permitted to pollute and poison that which was once a clear running stream, but which is now an open sewer of the foulest kind, emitting noxious effluvia sufficient to poison the 3,000,000 inhabitants who crowd its banks, might and would pay a high rate of interest upon the capital expended for conveying and collecting it, and making it useful for the fertilisation of millions of acres annually.

The Lord Mayor, as conservator of the river, has recently been throwing dust into the eyes of the public by giving circulation to a report, that the cause of the present foul state of the Thames was mainly attributable to the quantity of soil and matter deposited in the Brent Canal having been cleared therefrom and flushed into the Thames. Now, this is shere nonsense; for if the cubic contents of the Brent Canal referred to had been thrown into the Thames at one time, it would not have increased the specific gravity of the contents of the river between London Bridge and Chelsea, during the rise of one tide, to one tithe of the extent to which it has been effected by the constant and constantly-increasing discharges of sewage matter from the mouths of the new sewer-works recently constructed and in course of construction by the Sewers Commission of London.

Formerly we were permitted to store up the solid excrement in cesspools, allowing only the liquid matter to flow off and drain away. This we might use for fertilising purposes; and, injurious as the local effect might be, if proper precautions were not taken to overlay the solid excrement occasionally with some solid matter which prevented the free escape of the gases, or which neutralised their injurious effects, and when the opportunity served, these cesspools might be emptied. But now we are obliged, by Act of Parliament, to shoot the domestic filth from our houses down crooked pipes, along irregular and insufficient sewers, which have here and there pockets for collecting, and breaks and bars for stopping the free flow of what eventually would reach a great open sewer, where the steamers and their propellers keep in constant agitation the fluid mass of foul and stinking filth, which coming down in such immense quantities from the higher grounds of London, peopled by nearly 3,000,000 sewer-feeding inhabitants, who have the whole mass of impurity passing up and down under their noses at each rise and fall of the tide, and the slimy mass of filth deposited upon the banks of the river being exposed to the powerful rays of the sun, gives off immense quantities of gases most prejudicial to the human system.

It was thought that the recent visitations of cholera would have produced some effect in aiding the immediate remodelling of the system of sewage collection and drainage in London; but, like all such warnings, it seems to have been neglected by the men in power. Something must now be done, and five years is too long a time to wait for what is only *promised*, without means being taken at once to carry out a complete system for the whole metropolis, not for collecting and discharging the valuable sewage of this great metropolis wastefully, but a system by which the utilisation of the sewage may be made complete.

THE SHIPBUILDING TRADE OF DUMBARTON.

Though the shipbuilding trade of this port has for the last few months shown a slight falling off as compared with the corresponding period of last year, we are happy in being able to announce that orders have lately been received which, with those already on hand, will go far to make the ensuing season as prosperous a one as Dumbarton has yet seen. In consequence of the Messrs. Allan of Glasgow having secured the mail-service between Canada and this country, they have determined upon placing two screw-steamers on the station to run along with the *Indian* and *Canadian*, both built by Messrs. William Denny and Brothers, of this place; and being so well pleased with these vessels, the Messrs. Allan have resolved on giving the same firm the building of their two new ones. Irrespective of the above, Messrs. William Denny and Brothers have at present on the stocks, the *Cheliff*, a screw of 775 tons register, purchased by the Messageries Impériales, France, and which, it is expected, will be ready for launching on Saturday; another, a neighbour vessel in every respect, which will be ready for launching in about a fortnight; and a third, of 900 tons register, the frame of which is at present being put together. The French firm above mentioned have also purchased for the same purpose as the *Cheliff*—the mail-service between Marseilles and Africa—the screw-steamer lately launched by Mr. Alexander Denny, and named the *Stromboli* (*pro tem.*), and she will soon leave the harbour under her new name—the *Metidjah*. Mr. A. Denny has also at present on the stocks a screw of about 900 tons, to be launched eight weeks hence, and another of 350 tons, which is to be finished ten weeks after order, and is intended to ply on Lake Ontario. Another little steamer, intended to ply on a lake equally celebrated in its way, is at present being fitted up by him on the side of Loch Kathrine, and will be launched in a few days. This, we believe, will be the first vessel ever launched on the bosom of that romantic and world-renowned loch. In Mr. Archibald Denny's yard, business is in an equally satisfactory state, the keel of a screw-steamer 900 tons register having just been laid down. In Mr. M'Millan's yard, where "the wooden walls" are put together in all their beauty and strength, two vessels are at present on the stocks—one of 1,050 tons register, well forward, and another of 600 tons. In Messrs. Denny and Rankine's yard there is an equal sign of activity, one fine screw-steamer of 1,000 tons being well forward, and the keel of a small wooden vessel being laid down. At the engine-works of Messrs. Tulloch and Denny, who are at present making a large addition to their establishment, business is also in a flourishing state: besides other work, we believe they have on hand orders for the engines of most of the steamers we have noticed, excepting the *Cheliff* and the *Metidjah.—Dumbarton Herald.*

NOTES AND NOVELTIES.

The approaching Meeting of the British Association for the Advancement of Science, which is to be held in Glasgow in September next, has been arranged. The funds for the expenses of the meeting are stated to be ample.

A letter was recently read at one of the local meetings for arranging the preliminaries, in which Sir Roderick Murchison expressed his opinion that the meeting about to be held in Glasgow will be the most successful ever held in Great Britain; and certainly no locality can offer as many opportunities for witnessing the vast strides which have been made within the last few years in the arts, manufactures, and commerce, at the same time affording as much beauty of scenery and interesting places for the usual agreeable and interesting excursions.

More Materials for the Balaklava Railway.—Another instance of the promptitude and celerity with which private firms carry out their undertakings, and of which a notable example was afforded in the case of the Balaklava Railway, has just occurred. On Tuesday, the 17th ult., instructions were forwarded to Messrs. Peto, Brassey, and Betts, from the War Office, requesting them to take the necessary steps for hiring a steam-vessel to convey to the Crimea 130 railway-waggons, 40 drivers, 10 shoeing-smiths, and a supply of iron for shoes, the want of which has been much felt. The North of Europe Steam Navigation Company's steam-ship *Leipzic*, of 700 tons burden and 250 horse-power, was engaged for the voyage, and on Saturday was at Blackwall, with all her berths ready and her coals on board. The work of loading commenced immediately, and on the 28th she sailed. The men who go out in her must not be confounded with the navvy corps engaged by Sir J. Paxton for service in the trenches before Sebastopol. These latter are intended to relieve the army of some of its labours, and will consequently be exposed in common with it to all the hardships and dangers of the siege; but, on the other hand, they will be far better paid than the troops, and will not be subject to military discipline—a state of things not unlikely to produce much jealousy on the part of their martial fellow-labourers. The men sent out by Messrs. Peto, Brassey, and Betts, on the contrary, are engaged for the specific purpose of the railway, and for a specific time, and have nothing whatever to do with the operations of the siege.

According to letters from Galatz to the 8th ult., received by Messrs. Charles Joyce and Co., it appears that active measures were being taken to organise a regular system of transit for the produce of the southern provinces of Russia through the Austrian dominions, thus to neutralise, to some extent, the effects of the blockade of the ports on the Black Sea.

Wrought-Iron Cannon.—The large and beautifully-proportioned wrought-iron cannon constructed at Gospel Oak, in Staffordshire, burst and fell into many pieces on Wednesday, the 11th July, at Woolwich, under the usual charge. The gun was 10 inches in the bore, 10 feet long, and weighed 96 cwt.

The contract for the barrack-huts at Pembroke has been entered into by Mr. Jackson, of Pimlico. They are to accommodate 1,000 men, with an adequate staff, and are to be completed within 40 days. The militia regiments of Pembroke and the adjacent counties will then be brigaded there, and the Martello towers on the haven manned from them in monthly reliefs. At present there is not a soldier in one of them even to answer signals.

Telegraphic Communication with India.—The Turkish Government have granted an exclusive concession for a submarine telegraph from the Dardanelles to Alexandria. The communications from India will be accelerated from five to six days when this and the general system of telegraphs now constructing in European Turkey shall have been completed. Proposals are on foot for extending the project to India by carrying the communication *viâ* Suez and Aden to Kurrachee, at the mouth of the Indus, where it would connect with the lines already in operation, or in course of construction, by the East India Company throughout the various presidencies. The entire line to India may, it is estimated, be completed in two years.

Launch at Blackwall.—On Saturday, July 14th, a fine ship, of 1,700 tons, belonging to Mr. Richard Green, and christened the *Agamemnon*, was launched with all honours from that gentleman's yard, at Blackwall, and without the slightest incident occurring to mar the pleasures of the ceremony. The interior of the yard was crowded with people, as also Blackwall pier, and every available spot whence a view of the launch could be obtained; while most of the shipping in the East India Dock, particularly Mr. Green's ships, were gaily decked with every description of colours. The American ship *Titan*, in Mr. Green's dry dock, was fitted out for the accommodation of a most fashionable company, among whom we observed the American Minister, the Brazilian Minister, and many others.

Line of Steamers to the Havana.—G. and H. Fletcher and Co., of Liverpool, are making an attempt to establish a line of steamers between Liverpool and Havana. They have already received, as the pioneer vessel, a new screw-steamer called the *Havana*, of 1,500 tons, which is appointed to sail on the 22nd instant, under the Spanish flag. The increase of trade with the Havana leads to the expectation that the enterprise will be largely successful.

The Tiptree Gathering.—Mr. Mechi has fixed his annual agricultural gathering for Saturday, July 28th; so that ere our number is in the hands of our readers, there will have been, as usual, a large assembly of scientific and practical men to inspect the crops, and partake of the hospitality of the owner of the Hall.

Captain John M'Dougall, R.N., has been appointed Admiralty Superintendent of the Southampton Mail Packet Station. This officer was made captain in 1836, and will probably be an admiral before long, when he will cease to hold his appointment.

The contract for the erection of the Martello tower at Dale blockhouse, Milford Haven, has been taken by Mr. Fleetwood. It is to give a cross fire with others situated about the entrance of the haven, and is a portion of a scheme long since decided upon by the committee of fortifications for the protection of the port and arsenal.

NOTICES TO CORRESPONDENTS.

The Rhumkorff Coil.—The further information required will be communicated by post.

Whitworth's Street-sweeping Machines.—The descriptive pamphlet sent contains all particulars.

R. S. N.—We cannot promise to comply with your request next month, but will do so shortly.

F. B. E.—The engines of the *Cleopatra* are the ordinary beam-engines.

T. M. (Rostock).—We are obliged for your communication, and shall be glad to receive the promised particulars.

C. (Truro.)—The meetings of the learned societies for the session 1854-55 having terminated, our reports of the papers read, &c. cease until they resume. We intend, however, to give the paper on the Manufacture of Steel referred to by you.

W. N., Charles B., R. Newman, J. G. C., and Others.—We did not give Plate xlv. as a regular plate in Artizan style; but, instead of encumbering the pages of the Journal with woodcuts of the large size of the diagrams referred to, we thought it better (although much more expensive to us) to give them in a sheet: and we must remind you and our readers generally, that they are only transfers from the wood-blocks on to zinc. Our readers generally will appreciate the sheet, not for its style of execution, but for the subjects given.

Reviews, &c.—We are compelled, from want of space, to omit several notices of works, including the remainder on Colonel Baird Smith's Italian Irrigation—Colonel Cotton's Public Works in India—Main and Brown's Marine Engine, 3rd edition—&c. &c.

Notice.—The plate accompanying "American Notes" in present number, and illustrating Martin's Vertical Tubular Marine Boilers—the two plates of South Inlet Dock, Portsmouth Dockyard—the plate of Caisson for closing the entrance to South Inlet Dock—not being finished in time for the present number, they cannot be given until next month.

We intend, as far as practicable, next month to clear up arrears of original matter, correspondence, &c.

DIMENSIONS OF NEW STEAMERS OR SAILING VESSELS.

NEW IRON CLIPPER SAILING-BARQUE "L'IMPERATRICE EUGENIE."

Built by Messrs. Scott and Co., iron shipbuilders, Cartsdyke, Greenock, 1854.

Dimensions	ft.	tenths.
Length on deck	127	0
Breadth at two-fifths of midship depth	22	5
Depth of hold amidships	12	8
Length of quarter-deck	27	2
Breadth of ditto	20	0
Depth of ditto	1	5
Tonnage.	Tons.	
Hull	$242\frac{39}{100}$	
Quarter-deck	$8\frac{91}{100}$	
Register	$251\frac{30}{100}$	

This beautiful little craft has lately made the run from Glasgow to Moulmein, and thence to the Mauritius, and back to the Clyde, loading and discharging three full cargoes, in eight months and twenty days; a performance which ably sustains the reputation of the enterprising builders, and does credit to the abilities of the commander. This vessel carries about 372 tons of cargo; has a crew of 20 in number.

DESCRIPTION.

A bust female figure-head; no galleries; three masts; barque-rigged, square-sterned, and clinch-built vessel; standing bowsprit.

Port of Aberdeen. Commander, Mr. William Paterson Allan.

DIMENSIONS OF "IL MONTE CRISTO."

Built by J. and A. Blyth, at Mr. J. Thompson's Yard. Engines (of 50 nominal horse-power) by J. and A. Blyth

	ft.	inches.
Length between perpendiculars ...	110	0
Breadth of beam	17	0
Depth of hold at ditto	10	6
	Tons.	
Register, O. M.	$153\frac{39}{94}$	

Kind of engines, inclined and direct; do., boilers, tubular; diameter of cylinders, $27\frac{1}{2}$ inches; length of stroke, 1 foot 4 inches; diameter of screw, 7 feet; pitch of screw, 12 feet; blades of screw, 2 feet. Number of boilers, 1; length of do., 8 feet 3 inches; breadth of do., 11 feet 6 inches: load on safety-valve in lbs. per square inch, 20 lbs.; gross indicated power, 220 horse-power; average revolutions, 108; speed in knots with and against tide, average 12 miles. Classed at Lloyd's 14 years A 1.

DIMENSIONS OF "TACUARI."

Built by J. and A. Blyth, at Mr. J. Thompson's Yard. Engines (of 140 nominal horse power) by J. and A. Blyth.

	ft.	inches.
Length between perpendiculars ...	166	0
Breadth of beam	23	$0\frac{1}{2}$
Depth of hold at ditto	11	3
	Tons.	
Register, O. M.	$428\frac{24}{94}$	

Kind of engines, oscillating; do., boilers, tubular; diameter of cylinders, $47\frac{1}{4}$ inches; length of stroke, 3 feet 6 inches; diameter of paddle-wheel over boards, 16 feet 6 inches; length of boards, 9 feet; depth of do., 3 feet; number of do., 11. Number of boilers, 2; length of do., 8 feet; breadth of ditto, 15 feet 4 inches; height of do., exclusive of steam-chests, 9 feet 6 inches. Number of furnaces, 10; number of tubes, 600: load on safety-valve in lbs. per square inch, 20 lbs.; gross indicated power, 590 horse-power; draught forward and aft, average 5 feet 6 inches; average revolutions, 34; speed in knots with and against tide, average 12 knots. Intended service, war-steamer, Republic of Paraguay. Classed at Lloyd's 14 years A 1.

NEW IRON COASTING SCREW-PROPELLER STEAM-VESSEL "ANT."

Built by Messrs. Scott and Co., iron shipbuilders, Cartsdyke, Greenock; machinery by Messrs. Blackwood and Gordon, engineers, Paisley; 1854.

Dimensions.		ft.	tenths.
Length on deck		99	9
Breadth at two-fifths of midship depth		17	2
Depth of hold amidships		9	3
Length of quarter-deck		25	6
Breadth of ditto		15	1
Depth of ditto		2	4
Length of engine-room		22	8
Ditto of shaft-space		10	5
Tonnage.		Tons.	
Hull		$111\frac{92}{100}$	
Quarter-deck		$10\frac{04}{100}$	
Total		$121\frac{96}{100}$	
Engine-room ...	$39\frac{47}{100}$	$40\frac{38}{100}$	
Shaft-space	$0\frac{91}{100}$		
Register		$81\frac{58}{100}$	

A pair of inverted cylinder-engines of 20-horse nominal power: diameter of cylinders, 20 inches; length of stroke, 1 foot 8 inches. Screw-propeller: diameter, 6 feet 10 inches; pitch at centre, 12 feet $10\frac{1}{2}$ inches; ditto at circumference, 14 feet 6 inches; has two blades.

One tubular boiler: length at crown, 10 feet 2 inches; ditto at furnaces, 9 feet 7 inches; breadth, 6 feet 1 inch; depth, 8 feet 11 inches. Two furnaces: length, 6 feet 2 inches; breadth, 2 feet 2 inches. 86 tubes: diameter, 3 inches; length, 6 feet 6 inches. Chimney (bell-top): diameter, 2 feet 7 inches; length, 20 feet 6 inches. Melbourne, January 14th, 1855, arrived from Belfast, having sailed out under canvas. Has accommodation for a few passengers, and carries about 109 tons of cargo.

DESCRIPTION.

Has a billet figure-head; no galleries; round-sterned and clinch-built vessel; standing bowsprit; two masts; brig-rigged.

Port of Belfast. Commander, Mr. Maguire.

LIVERPOOL AND WEST INDIA PACKET-SHIP "MOULIN."

Built by Messrs. James M'Millan and Son, shipbuilders, Greenock, 1855.

Builders' measurement		ft.	in.
Length of keel and fore-rake ...		135	7
Breadth of beam		27	5
Tonnage		$421\frac{64}{94}$ tons.	
Customs' measurement.		ft.	tenths.
Length on deck		132	5
Breadth at two-fifths of midship depth		23	7
Length of break-deck No. 1 ...		22	6
Breadth of ditto		21	9
Depth of ditto		3	5
Length of break-deck No. 2 ...		11	2
Breadth of ditto		19	0
Depth of ditto		3	2
Tonnage.		Tons.	
Hull		$380\frac{88}{100}$	
Break-deck No. 1 ...	$18\frac{17}{100}$	$25\frac{47}{100}$	
Ditto No. 2	$7\frac{30}{100}$		
Register		$406\frac{35}{100}$	

Classed ten years A 1 at Lloyd's. Was launched from the yard of the builders on the 9th of March. Has accommodation for a few passengers, and will carry about 582 tons of cargo. Sailed from the tail of the Bank, Greenock, for Demerara, on the 8th of May.

DESCRIPTION.

A billet figure-head; no galleries; square-sterned and carvil-built vessel of timber; standing bowsprit; three masts; ship-rigged; two decks, and two break ditto. Owners, Messrs. Duff, M'Inroy, and Co.

Port of Liverpool. Commander, Mr. William Jump (late of the *Mahaica*).

NEW IRON SCREW-PROPELLER COASTING STEAM-VESSEL "ALMA."

Built by Mr. Thomas B. Seth, iron shipbuilder, Kelvin Bank, Portick, Glasgow; machinery by Messrs. Anthony and John Inglis, Whitehall Works, ditto; 1854.

Builders' measurement	ft. in.
Length of keel and fore-rake ...	115 0
Breadth of beam	18 0
Length of engine-room	21 8
Tonnage.	Tons.
Hull	$179\frac{54}{94}$
Engine-room	$37\frac{21}{94}$
Register	$142\frac{33}{94}$
Customs' measurement.	ft. tenths.
Length on deck	112 4
Breadth at two-fifths of midship depth	17 1
Depth of hold amidships	8 8
Length of engine-room	21 7
Tonnage.	Tons.
Hull	$131\frac{50}{100}$
Engine-room ... $35\frac{34}{100}$ / Shaft-tunnel ... $1\frac{39}{100}$	$36\frac{73}{100}$
Register	$94\frac{77}{100}$

A pair of non-condensing inverted cylinder-engines of 35 horse-power: diameter of cylinders, 14 inches; length of stroke, 1 foot 8 inches. Screw-propeller: diameter, 5 feet 10 inches; pitch, 10 feet; has three blades. One horizontal tubular boiler: length, 10 feet 6 inches, and 5 feet 10 inches in diameter. One furnace: length, 4 feet; breadth, 5 feet. 103 brass tubes: diameter, 2 inches; length, 8 feet. Chimney: diameter, 2 feet; length, 16 feet. Contents of coal-bunkers, 15 tons. Stem, keel, and stern-post, $3\frac{1}{2} \times 1\frac{1}{4}$ inches; frames, $3 \times 2\frac{1}{2} \times \frac{5}{16}$ inches, and 18 inches apart. Steam-pressure, 60 lbs. per square inch on safety-valve; 120 revolutions per minute. Has run 450 miles in $41\frac{1}{2}$ hours, consuming $6\frac{1}{2}$ tons of coals; carries 150 tons of coals on 7 feet 3 inches water; has accommodation for six cabin passengers. Launched December the 26th, and the first vessel launched into the Kelvin.

DESCRIPTION.

A demi-male figure-head; no galleries; round-sterned and clinch-built vessel; one and a quarter decks; clipper-bow; standing bowsprit; three masts (pole); schooner-rigged. Owners, Boyd Stewart, Thomas Steele, and Gilbert M'Ewan.

Port of Ayr. Commander, Mr. Charles Oman (late of the screw-steamer *Tintern*).

GLASGOW AND VAN DIEMEN'S LAND NEW IRON CLIPPER SAILING-SHIP "STORM CLOUD."

Built by Messrs. Alexander Stephen and Sons, shipbuilders, Kelvin-Haugh, Glasgow, 1854.

Dimensions.	ft. tenths.
Length on deck	195 3
Breadth at two-fifths of midship depth	30 0
Depth of hold	20 4
Length of poop	54 9
Breadth of ditto	29 6
Depth of ditto	6 6
Tonnage.	Tons.
Hull	$791\frac{56}{100}$
Poop	$116\frac{97}{100}$
Register (total)	$907\frac{53}{100}$

This vessel was launched in August last. The general build and configuration were so far out of the usual run of clipper-ships, that a great deal of attention was excited, as the vessel lay on the stocks, amidst old salts and shipowners, as to the result of so daring a departure from the ordinary form of ships. We were of opinion that the *Storm Cloud* would prove one of the fastest vessels, if not the quickest, that ever left the Clyde; and the result has so far verified the opinion we then formed. Sailed from the Clyde for Melbourne in September last, encountering heavy gales and contrary winds for the first three days, so that it took six weeks to reach the Line, a distance of 4,000 nautical miles. From the Line to the Cape was sailed in 22 days more, and the remainder of the distance, from the Cape to Melbourne, about half the entire passage, was run in the unprecedented short space of 20 days. On one day the *Storm Cloud* logged 345 nautical, or about 400 English miles. Several times 15 to 16 knots were run off the Line, with the wind on the quarter, and 12 when close-hauled $5\frac{1}{2}$ points from the wind. The keel of this vessel cambered upwards for about 30 feet forward, and to less degree aft. The inference from this curvature of the keel was, that the ship would be very handy in stays, which has proved to be the case; and she also steers well, and is an excellent and easy sea-boat. Took out a large cargo, and 73 passengers, who were landed in good health, and spoke highly of the ship and crew.

DESCRIPTION.

A bust woman figure-head; round-sterned and clinch-built vessel; no galleries; standing bowsprit (on the telescopic principle, and of iron); three masts; ship-rigged. Owned by the builders.

Port of Glasgow. Commander, Mr. James Campbell.

DIMENSIONS OF "TACHTALIA."

Built by J. and A. Blyth, at Messrs. Wigram's Yard. Engines (of 40 nominal horse-power) by J. and A. Blyth.

	ft. inches.
Length on deck	151 0
Breadth of beam	20 0

Kind of engines, horizontal and direct; do., boiler, tubular; two pairs of engines and four paddle-wheels; diameter of cylinders, 18 inches; length of stroke, 1 foot 2 inches; diameter of paddle-wheel over boards, 6 feet; length of boards, 6 feet; depth of do., 1 foot; number of do., 7. Number of boilers, 1; length of do., 11 feet; breadth of do., 7 feet 3 inches and 6 feet 3 inches; height of do., 7 feet 6 inches. Number of furnaces, 4; number of tubes, 292: load on safety-valve in lbs. per square inch, 20 lbs.; gross indicated power, 164 horse-power; draught forward and aft, $12\frac{1}{2}$ inches; average revolutions, 92 per minute; speed in knots with and against tide, average 11 miles. Intended service, navigation of Iron Gate of Danube.

NOTES OF THE MONTH, &c.

Greenock, May 1.—Was launched, by Messrs. Caird and Co., iron shipbuilders, a beautiful screw-steamer, named the *Hammonia*, for the Hamburgh and American trade.

Renfrew, May 1.—Was launched, a very handsome screw-steamer, by Messrs. James Henderson and Sons, for the East India trade. Owned by a native company.

Glasgow, May 3.—There was launched from the building-yard, Meadow-side, by Messrs. Tod and M'Gregor, iron shipbuilders and engineers, a fine-looking screw-propeller steamer, the *Ava*, the property of the Peninsular and Oriental Steam Navigation Company of London. Intended for the station between Suez and Calcutta. 1,700 tons.

Dumbarton, May 7.—Messrs. Denny and Rankin, shipbuilders, Castle-green, launched a ship-rigged screw steam-vessel—machinery by Messrs. Randolph, Elder, and Co., Glasgow—of 180 horse-power; boiler capacity for 300 horse-power.

Troon, May 10.—The Portland Shipbuilding Company launched from their yard a very handsome clipper sailing-ship, named the *James Paton*, for the foreign trade, &c. Is named in honour of James Paton, Esq., of Macnairston, who is principal owner. The vessel will be commanded by Mr. James Brown, late of the ship *William Gillies*.

Glasgow, May 14.—There was launched by Mr. Thomas B. Seth, Kelvin Bank, Portick, a beautiful river-steamer—named the *Nelson*, by Miss Williamson, of Ayr—built to ply in consort with the *Wellington*, in room of the *Eclipse*, lately lost. Keel laid on the 5th of March; the machinery was put on board on the 15th of May, the morning after the launch (making 2 months and 10 days). Owned by Alexander M'Kellar and Son, Glasgow. Will be commanded by Mr. John Borrie.

Glasgow, May 15.—By Messrs. Robert Barclay and Curle, was launched the *Shandon*, clipper sailing-ship, for the Clyde and Montreal trade. Owned by Messrs. William Kidston and Sons, Glasgow. Is 880 tons. Commander, Mr. Walter Greig.

Glasgow, May 17.—Launched by Messrs. Robert Napier and Sons, Govan, the *Earl of Erne*, paddle-wheel steamer, for the Dundalk and Liverpool trade—700 tons—and named by Mrs. J. S. Napier. Will be commanded by Mr. John Williams, late of the *Pride of Erin*.

Renfrew, May 19.—Launched by Messrs. J. W. Hoby and Co., London Works, the *Rattler*, a powerful steam-tug paddle-steamer, for the Liverpool Steam Tug Company. Was launched with all the machinery on board, and named by Mrs. Jevon, from Liverpool. Length over all, 156 feet; beam, 23 feet; 500 tons; 160 horse-power. Side lever engines, and is a very creditable job.

Glasgow, May 28.—Messrs. James and George Thomson launched, from their yard, Cessnock Bank, the screw-steamer *Forth*, of 500 tons, and 100 horse-power; the property of the Carron Company.

Greenock, May 30.—Messrs. Scott and Co., Cartsdyke, launched a paddle-steamer for towing through the intricacies of Moulmein river: 200 tons; 100 horse-power; the machinery by Messrs. Blackwood and Gordon, Paisley. They have also on the stocks another steamer, similar to this one, for the same owners and trade.

Glasgow, June 1.—Messrs. Robert Barclay and Curle launched, from their yard at White Inch, the screw-steamer *Earl of Carrick*, for coasting trade.

Dumbarton, June 8.—Mr. Archibald Denny launched the screw-steamer *Lord Raglan*, for the Newcastle and Rotterdam trade.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 13th March, 1855.

558. A. E. L. Bellford, 32, Essex-street, Strand—Musical wind instruments. (A communication.)

Dated 20th March, 1855.

627. H. T. Williams, Guildford-street—Easel.

Dated 25th April, 1855.

935. F. J. Anger, 16, Stamford-street—Metallic alloy. (A communication.)

Dated 27th April, 1855.

962. E. Muller, and J. and X. Gilardoni, Paris—Hooked tile.

Dated 1st May, 1855.

974. G. W. Knocker, Dover—Motive power.

Dated 9th May, 1855.

1046. S. C. Lister, Bradford—Preparation of fibres for spinning.

Dated 16th May, 1855.

1101. W. Latham, Liverpool—Fabrics for saddle-covers.

Dated 17th May, 1855.

1119. W. Smith, 10, Salisbury-street, Adelphi—Machine for cleaning cotton. (A communication.)

Dated 23rd May, 1855.

1158. L. Ochs, St. Josse ten Noode, near Brussels—Paper from leather. (A communication.)

Dated 26th May, 1855.

1195. W. S. Young, Leith—Prevention of smoke.

Dated 28th May, 1855.

1212. Captain E. G. Swinton, Warrash House, near Titchfield—Grinding corn.

Dated 2nd June, 1855.

1265. H. Galante, Paris—Surgical injection bottle.

Dated 4th June, 1855.

1267. M. Staite, Liscard—Black paint.
1269. G. H. Ingall, Bartholomew-lane—Railway couplings.
1271. W. H. Graveley, 40, Upper East Smithfield—Cooking apparatus.
1273. E. Morewood and G. Rogers, Enfield—Coating sheets of wrought-iron.
1275. W. E. Newton, 66, Chancery-lane—Ships' auger. (A communication.)

Dated 5th June, 1855.

1267. F. Puls, Soho-square—Electro-coating iron.
1277. J. Gedge, 4, Wellington-street south, Strand—Curry-combs. (A communication.)
1279. J. Gedge, 4, Wellington-street south, Strand—Distribution of motive power. (A communication.)
1281. T. Barrows, Massachusetts—Treatment of wool.
1283. T. Barrows, Massachusetts—Treatment of wool.
1285. J. Tenwick, 24, Orchard-hill, Lewisham-road—Water-gauges.

Dated 6th June, 1855.

1289. J. Gedge, 4, Wellington-street south—Flat tiles. (A communication.)
1291. P. Lolmède, Saux, France—Instrument for administration of medicinal substances.
1293. H. Leech, J. Robinson, and R. Burrows, Preston—Spinning machinery.
1295. H. Nunn, Mabledon-row, New-road—Invalid carriages.
1297. W. Baines, Hunter's-lane, near Birmingham—Railways.

Dated 7th June, 1855.

1298. P. A. Favre, Marseilles—Employment of residue arising from lixiviation of crude sodas.
1299. J. Ramsbottom, Longsight, near Manchester—Safety-valves and feeding apparatus.
1301. M. Heap, Blackburn—Grinding dye-woods or roots.
1303. A. Orange, Edinburgh—Representations of articles for sale.
1305. D. Fehrman, Liverpool—Lamps. (A communication.)
1307. R. A. Tucker, Lenton—Using gas and smoke arising during combustion.

Dated 8th June, 1855.

1309. R. Caunce, Bolton-le-Moors—Sizeing, dressing, and warping yarn.
1310. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Iron shovels. (A communication.)
1311. F. Weaver, Handsworth—Grinding bones.
1312. I. Lippmann, Paris—Leather.
1313. G. F. Chantrell, Liverpool—Charcoal.

Dated 9th June, 1855.

1314. H. Sibille, Paris—Decortication and preserving of grain.
1315. J. S., E. J., and J. H. Nettlefold, Holborn—Locks. (A communication.)
1316. E. J. Lafond, and Count de Chatauvillard, Belleville, Paris—Lighting.
1317. H. Teague, Lincoln—Meters.
1318. C. F. Varley, 1, Charles-street, Somers-town—Electric telegraphs.
1319. T. Bright, Carmarthen—Prevention of waste in water or other fluid supplies.
1320. M. J. Cooke, Newcastle—Preserving food.
1321. J. Robinson, Poplar—Tables.
1322. J. Greenwood, Irwell Springs, Bacup—Purifying oils.
1323. S. Colt, Pall-mall—Fire-arms.
1324. S. Colt, Pall-mall, and W. T. Eley, Broad-street, Golden-square—Cartridges.

Dated 11th June, 1855.

1325. W. K. Hall, Mark-lane—Railway-breaks.
1326. H. B. Barlow, Manchester—Cotton machinery. (A communication.)
1327. F. C. Bakewell, 6, Haverstock-terrace, Hampstead—Bench-planes. (A communication.)
1328. J. D. Kind, Birmingham—Lock spindles and handles.
1329. J. L. Casartelli, Manchester—Pressure and vacuum gauges.
1330. E. V. Gardner, 24, Norfolk-street, Middlesex-hospital, and J. H. Walker, Cole-street, Dover—Separating vegetable substances from fabrics containing wool, and preparing wool for re-manufacture.
1331. W. Barrington, Limerick, and W. R. Le Fann, Dublin—Joining bridge-rails.
1332. F. T. S. Bards, Royal Exchange—Card-cases.
1333. J. H. Johnson, 47, Lincoln's-inn-fields—Metallic pens. (A communication.)
1334. J. H. Johnson, 47, Lincoln's-inn-fields—Governors. (A communication.)
1335. I. Lippmann, Paris—Dyeing skins.

Dated 12th June, 1855.

1336. I. J. Liebisch, London—Rails for railways.
1337. W. Armitage, Manchester—Union bags and sailcloth.
1338. N. Hackney, Hull—Earthenware, china, and porcelain.
1339. S. Coulson, Sheffield—Sulphate of baryta.
1340. W. B. Johnson, Manchester—Steam-boilers and safety-valves.
1341. T. Metcalfe, High-street, Camden-town—Collapsible hats and bonnets.
1342. C. Parker, Dundee—Weaving.
1343. H. W. Ford, Gloucester—Agricultural machinery.
1344. J. C. Brant, 8, Surrey-square, Old Kent-road—Permanent way.

Dated 13th June, 1855.

1345. F. C. Bakewell, 6, Haverstock-terrace, Hampstead—Supplying furnaces with hot air. (A communication.)
1346. F. C. Bakewell, 6, Haverstock-terrace, Hampstead—Rotating breech fire-arms. (A communication.)
1347. J. Avery, 32, Essex-street, Strand—Oscillating steam-engines. (A communication.)
1348. W. J. Blackman, Kensington—Cough-syrup.
1349. E. R. and F. Turner, Ipswich—Grinding grain.
1350. W. Moxon and J. Clayton, Rochdale—Looms.
1351. H. H. Henson, Parliament-street—Portable buildings.
1352. J. Betteley, Liverpool—Iron knees for shipbuilding.
1353. J. Betteley, Liverpool—Ships' anchors.
1354. G. Cottam, Winsley-street, Oxford-street—Hay-racks and harness-brackets.
1355. G. A Biddell, Ipswich—Grinding machinery.
1356. E. Lodge, Mirfield, and G. Marshall, Huddersfield—Animal and vegetable naphtha, ammonia, and charcoal.

Dated 14th June, 1855.

1357. G. Sinclair, Regent-street—Signalling between railway guards and drivers.
1359. J. Enouy, 31, Denbigh-street, Pimlico—Revolving fire-arms.
1360. A. Robertson, Islington—Packages.
1361. F. Leloup, Paris—Separating cotton from wool, silk, &c. (A communication.)
1362. S. C. Lister, Manningham—Treating silk waste.
1363. J. T. Chance, Birmingham—Glass fattening furnaces. (A communication.)

Dated 15th June, 1855.

1364. W. Hewitt, Bristol—Propelling vessels.
1365. W. Clay, Liverpool—Bar-iron.
1366. W. Clay, Liverpool—Peculiar application of bar-iron.
1367. H. Bridgewater, Alfred-place, Bedford-square—Spike.
1368. W. Lee, Duke-street, Westminster—Water-closets.
1369. H. Mathis, Paris—Preserving wood. (A communication.)
1370. J. H. Sadler, Hunslet, Leeds—Looms.
1371. G. F. Morrell, Fleet-street—Ink-bottles.

Dated 16th June, 1855.

1372. D. Pallier, Broad-street, Lambeth—Soap.
1373. W. Jones, Birkenhead—Punching machinery.
1374. J. Webster, Birmingham—Balance.
1375. L. F. Vaudelin, Upper Charlotte-street, Fitzroy-square—Railway breaks.
1376. J. Lowe, East Greenwich—Propelling vessels.

Dated 18th June, 1855.

1377. J. Sellars, Monsall-house, near Manchester—Starch.
1378. J. Carlhian and J. Corbiere, 27, Castle-street, Holborn—Moderator lamps.
1379. L. H. Réal, Paris—Elastic seatings for beds, &c.
1380. R. Peaker, Methley, and T. Bentley, Wakefield—Grinding machinery.
1381. W. H. Wilding, New-road—Furnaces.
1382. H. Bessemer, Queen-street-place, New Cannon-street—Screw-propellers.
1383. W. Little, Strand—Printing machinery.
1384. H. Bessemer, Queen-street-place, New Cannon-street—Cast-steel, and mixture of steel and cast-iron.
1385. T. Blanchard, Paris—Bending timber.
1386. H. Bessemer, Queen-street-place, New Cannon-street—Ordnance.
1387. H. Francis, 456, West Strand—Cutting out garments.
1388. H. Bessemer, Queen-street-place, New Cannon-street—Rolls or cylinders.
1389. E. Myers, Rotherham—Raising liquids.
1390. H. Bessemer, Queen-street-place, New Cannon-street—Railway wheels.
1391. E. Myers and J. W. Potter, Rotherham—Buffers, and draw and bearing springs.
1392. J. Jones, Sheffield—Motive power.
1393. J. H. Johnson, 47, Lincoln's-inn-fields—Furnaces. (A communication.)

Dated 19th June, 1855.

1394. C. A. Hartmann, Paris—Colours for fabrics.
1395. J. F. Norton, Manchester—Measuring liquids. (A communication.)
1396. E. Dixon and T. Bailey, Wolverhampton—Tap.
1397. F. Burke, Montserrat, W. Indies—Paper material.
1398. J. Macintosh, Great Ormond-street—Fusees.
1399. D. Dover, King-street, Long-acre—Gun-carriages.
1400. J. Letchford, Duncan-place, Hackney—Folding bedstead.
1401. J. H. Johnson, 47, Lincoln's-inn-fields—Emptying cesspools. (A communication.)
1402. J. H. Johnson, 47, Lincoln's-inn-fields—Storing grain. (A communication.)
1403. J. H. Johnson, 47, Lincoln's-inn-fields—Dish-covers, &c. (A communication.)

Dated 20th June, 1855.

1404. D. B. Herts, 17, Cornhill—Life-preserving harness. (A communication.)
1406. R. B. Longridge, Manchester—Boilers and tubes.
1408. J. Gernon, 14, Buckingham-street, Adelpbi—Articles of clay. (A communication.)
1409. J. Gernon, 14, Buckingham-street, Adelphi—Plaster of Paris and cement. (A communication.)
1410. R. Walker and A. M'Kenzie, Glasgow—Electric telegraphs.
1412. R. W. Savage, St. James's-square—Swing-doors.
1413. U. Lane, Brighton—Pumps.
1414. E. Cochand, Paris—Aërated liquids.
1415. L. Pol, Paris—Pianofortes.
1416. W. E. Newton, 66, Chancery-lane—Finishing thread. (A communication.)
1417. T. F. V. Fabien, Paris—Wheels. (A communication.)

Dated 21st June, 1855.

1418. J. L. Jullion, Tovil—Paper, card, and millboard.
1419. W. C. Wilkins, Long-acre—Lamps.
1420. P. F. Rioux, Paris, and L. de Pariente, Schaerbeck, next Brussels—Fixing metallic ornaments upon fabrics. (A communication.)
1421. M. Shelley, 12, Union-crescent, Kingsland-road—Cooking utensils.
1422. J. R. Birch, Liverpool—Boat-plug.
1423. J. Benjamin, Leadenhall-street—Gas. (A communication.)
1424. T. Bongereau, 46, Lime-street—Roasting coffee.
1425. R. Keevil, Lacock, Chippenham—Vessels used in manufacture of cheese.
1426. W. Basébé, 2, Mayfield-place, Kensington—Paper.
1427. C. E. Green, 13, Blandford-street, Portman-square—Huts, tents, and camp hospitals.
1428. L. Young, Bow-lane, Cheapside—Gas regulators.
1429. T. C. W. Pierce, Manchester—Machinery for finishing yarns.
1430. A. E. L. Bellford, 32, Essex-street, Strand—Steam-engines. (A communication.)

Dated 22nd June, 1855.

1432. O. R. Chase, Boston, U.S.—Macbine for making lozenges.
1434. S. White, Liverpool—Washing, cleansing, and drying grain.
1436. A. E. L. Bellford, 32, Essex-street, Strand—Breech-loading fire-arms, and cartridges. (A communication.)
1438. J. G. N. Alleyne and H. Strafford, Alfreton—Railway breaks.

Dated 23rd June, 1855.

1440. S. T. M. Sorel, Paris—Applying adhesive matters on stuffs.
1442. F. W. Mowbray, Shapley, near Leeds—Looms.
1446. A. E. L. Bellford, 32, Essex-street, Strand—Bats for felting. (A communication.)

Dated 25th June, 1855.

1448. J. Young, Linton, Roxburghshire—Harrows.
1450. J. Page, Perth—Moulding metals.
1452. M. Poole, Avenue-road, Regent's-park—Sculpturing surfaces of marble and stone. (A communication.)

Dated 26th June, 1855.

1454. A. E. L. Bellford, 32, Essex-street, Strand—Rotary blowing machines. (A communication.)
1456. F. Leiss and C. Schneider, Hesse Darmstadt—Mica letters, figures, &c.
1458. M. Poole, Avenue-road, Regent's-park—Printing rollers. (A communication.)
1460. F. Vennin-Deréguiaux, Lille—Spinning machinery.
1462. J. J. Bucknall, Liverpool—Hats and caps.
1464. J. M. Clements, Birmingham—Spring lock fastening for pockets, &c.

DESIGNS FOR ARTICLES OF UTILITY.

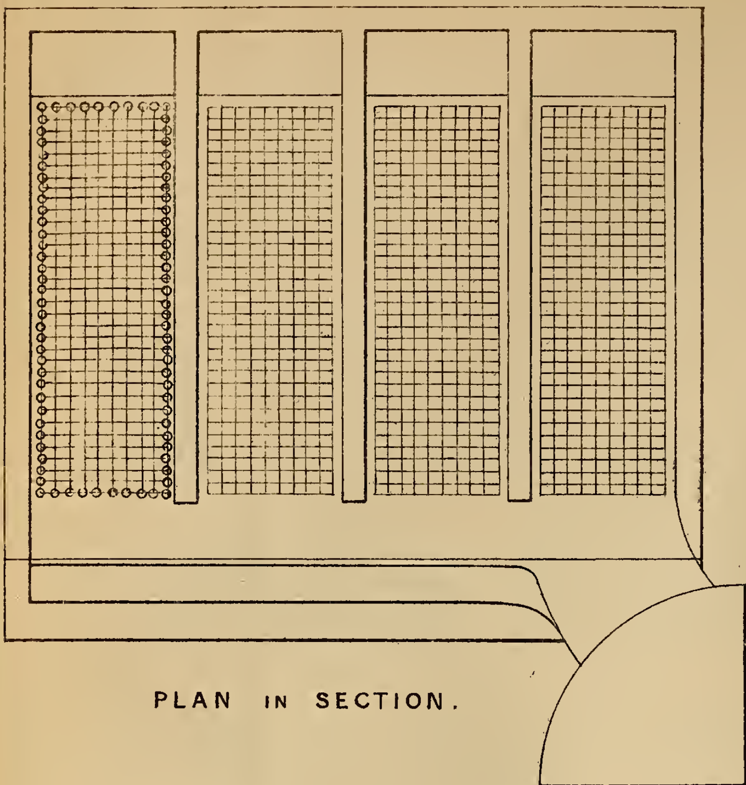
1855.

June 22. 3731. Wm. Mountcastle and Son, Manchester, "A mourning hat."
" 22. 3732. Captain John Olive, Liverpool, "Improved valve-plug for the bottom of ships' boats and boats in general."
" 26. 3733. John Martyn Fisher, Taunton, "The Luffer chimney-top."
July 9. 3734. Abbott and Forrest, Blackburn, Lancashire, "An improved valve for regulating the pressure of steam from steam-boilers."

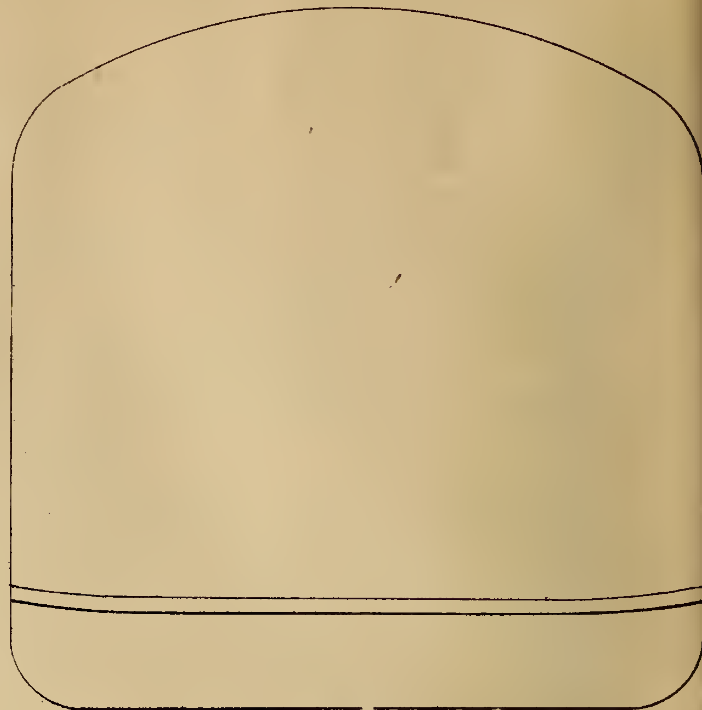
VERTICAL TUBULAR BOILER

DESIGNED BY D. B. MARTIN, ENGINEER IN CHIEF, U. S. N.

1855.

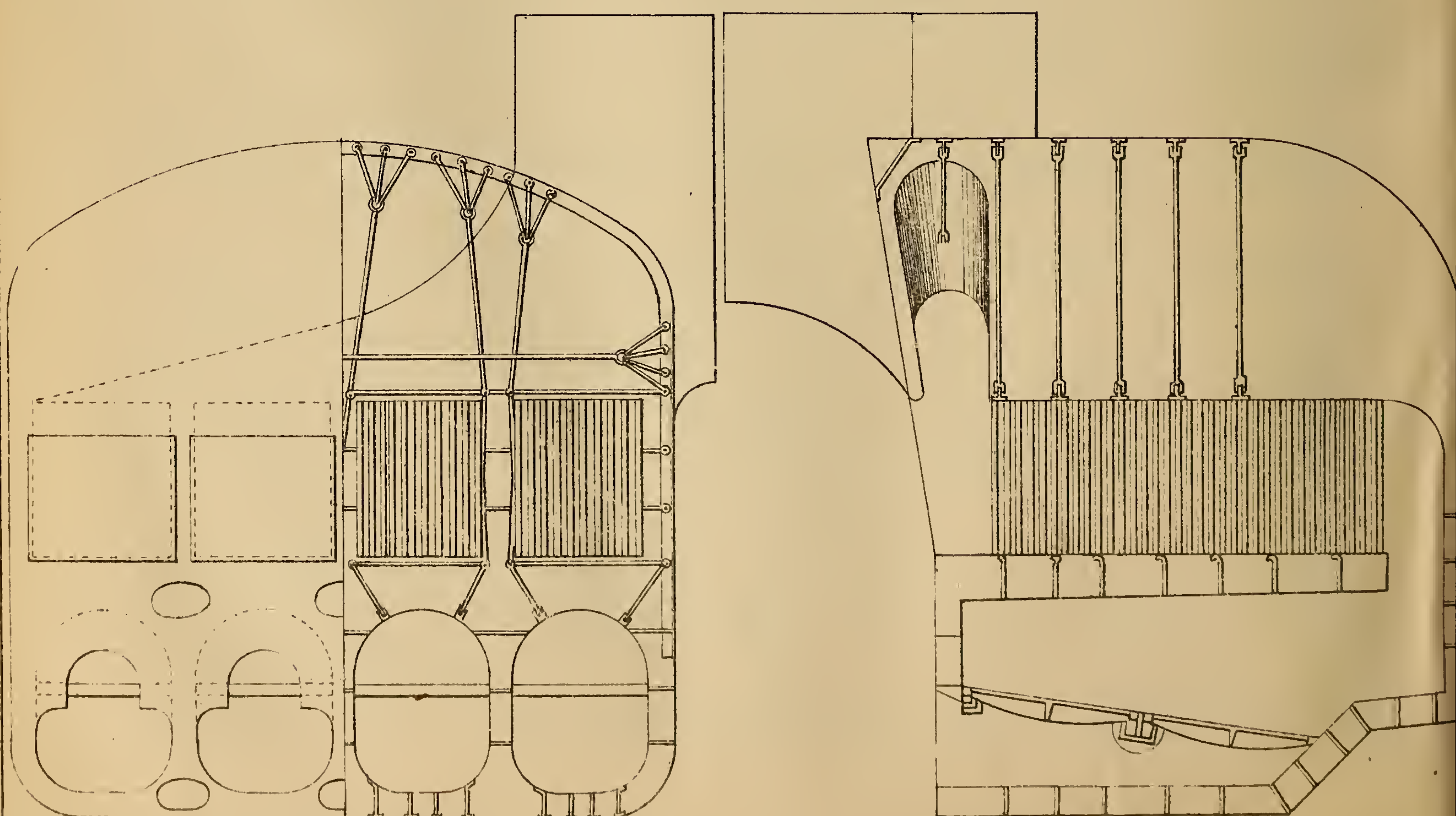


PLAN IN SECTION.



BACK VIEW.

Shewing Curvation of Back Water Bottom.



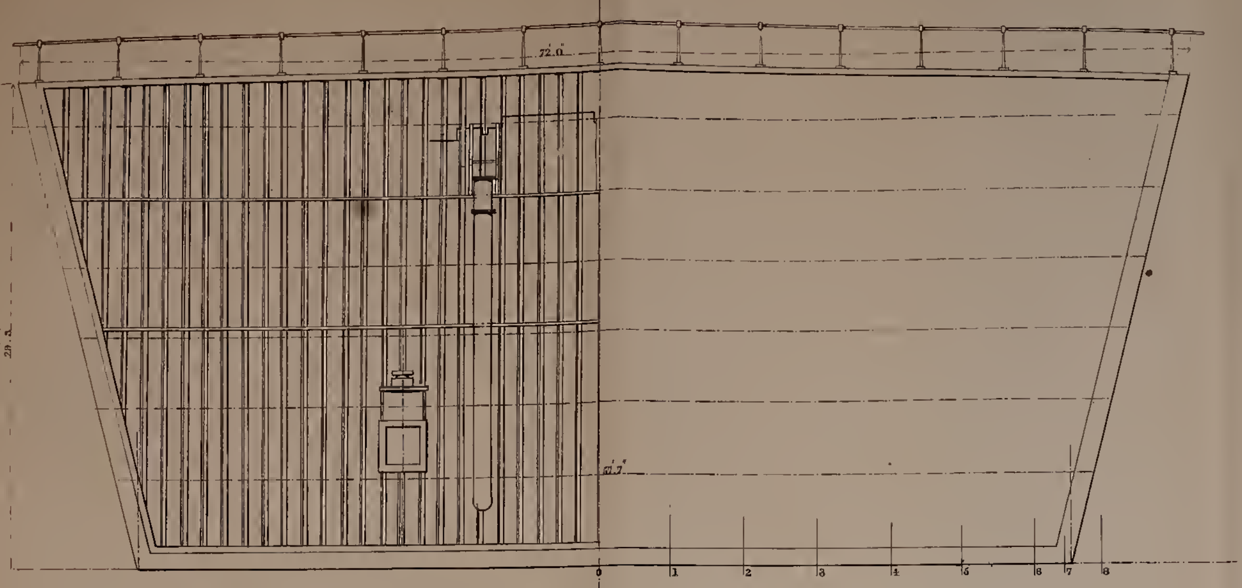
ELEVATION. SECTION. SCALE, 1/4 INCH TO 1 FOOT. LONGITUDINAL SECTION.

CAISSON (SOUTH INLET DOCK) AT H.M. DOCKYARD PORTSMOUTH

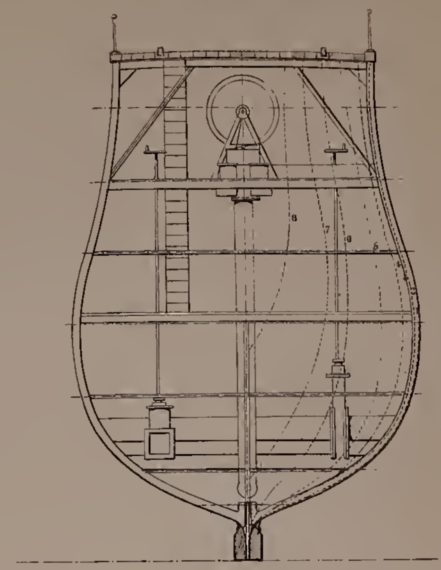
Designed by Henry Wood, Esq.re Clerk of Works, Portsmouth Yard.

Constructed by Mess.rs Mares & Co. London.

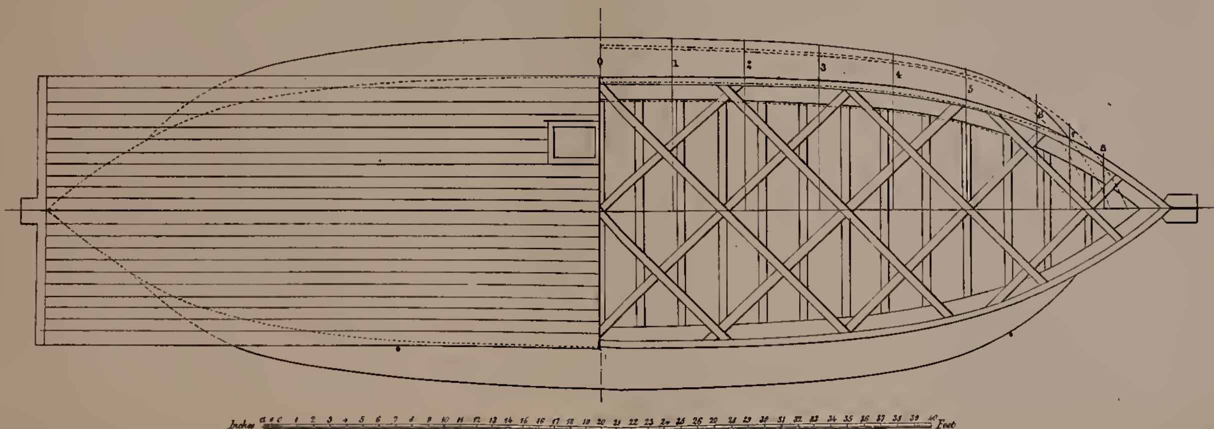
ELEVATION



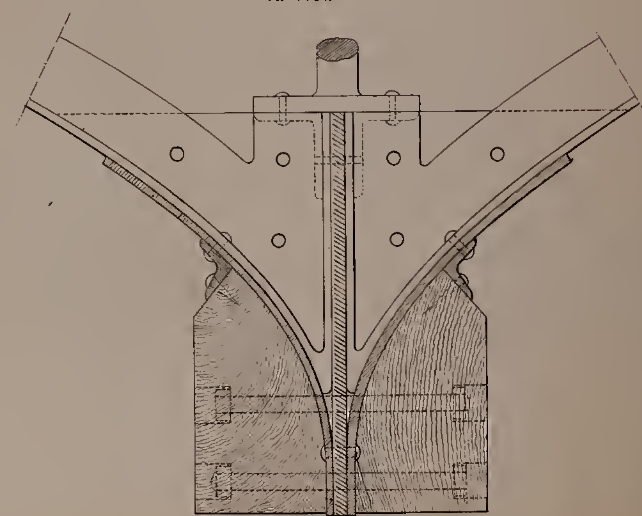
TRANSVERSE SECTION.



PLAN



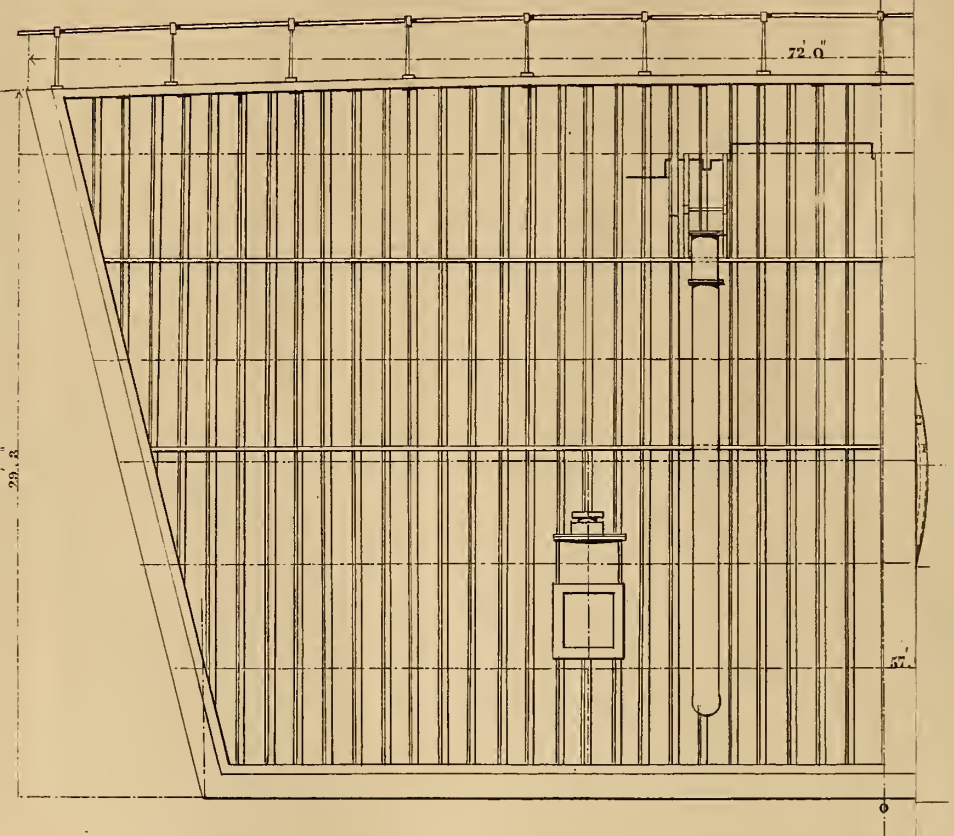
SECTION OF KEEL



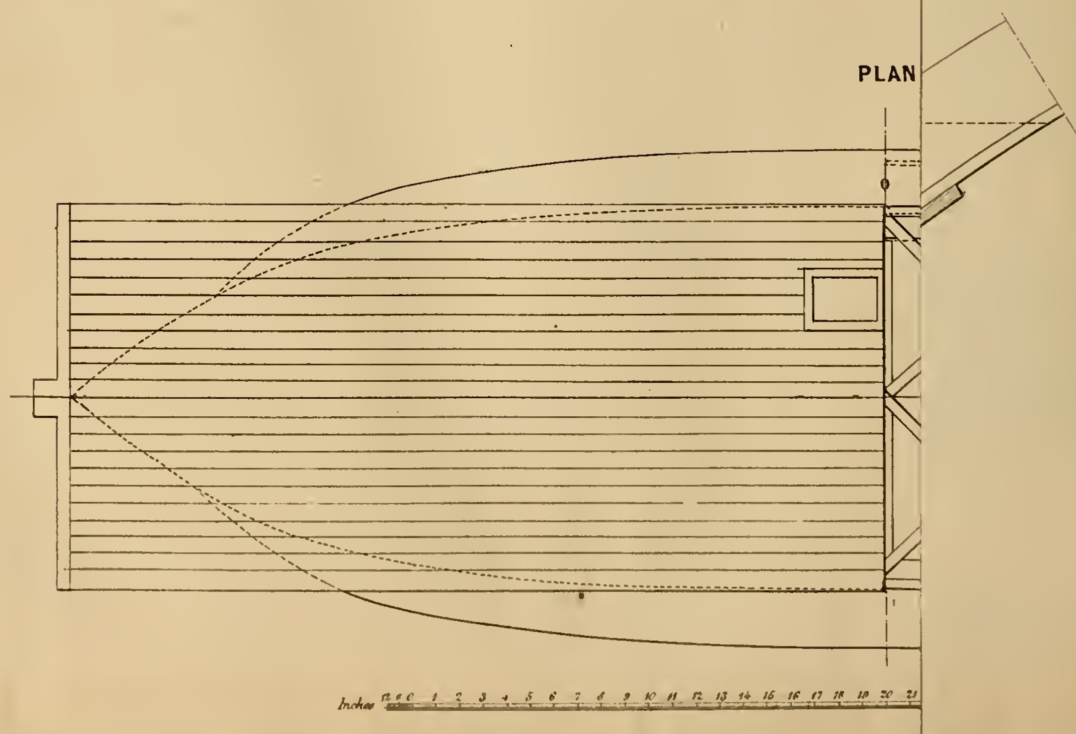
Scale 3 inches to a foot

CAISS

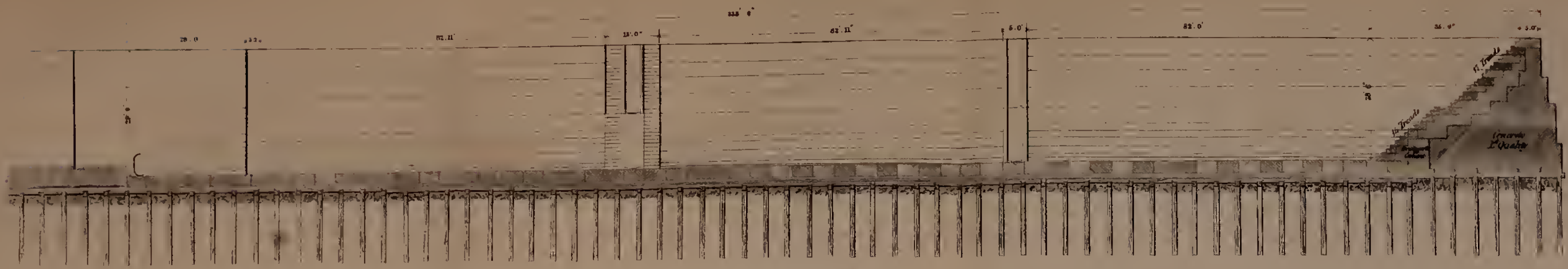
ELEVATI



PLAN

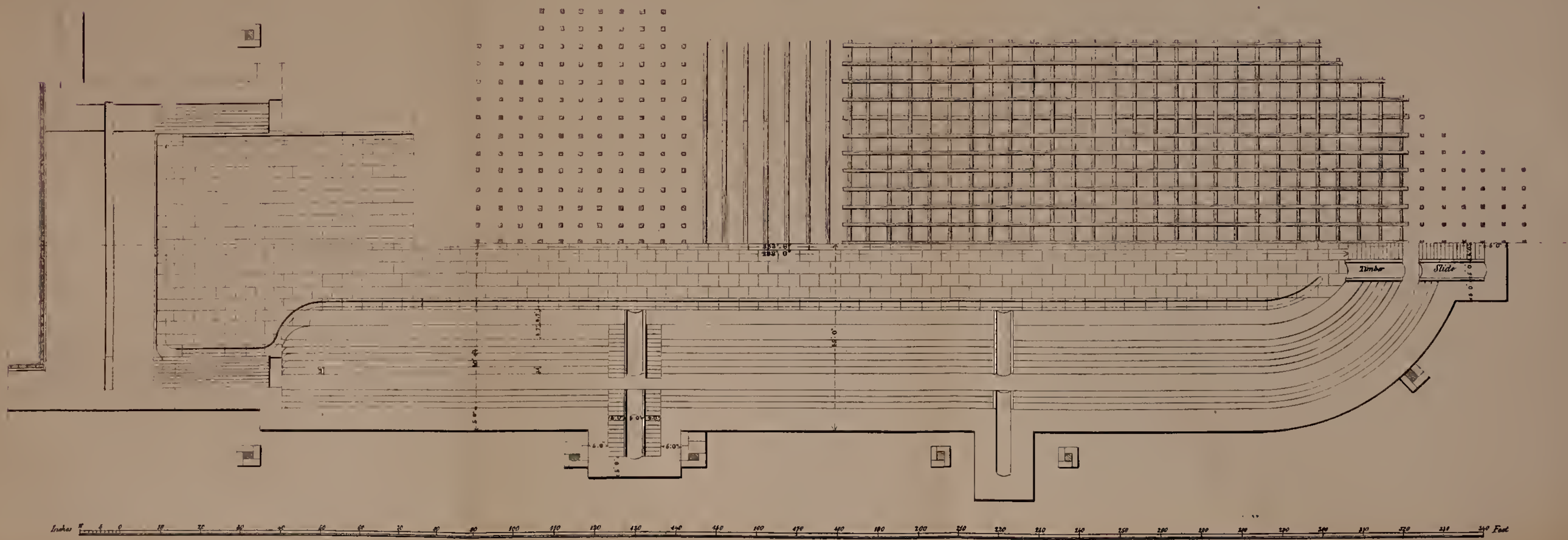


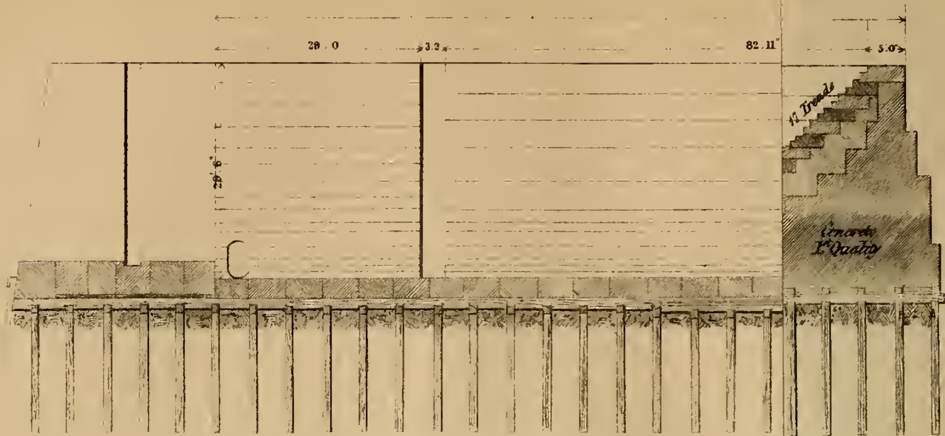
SOUTH INLET GRAVING DOCK. H.M. DOCKYARD, PORTSMOUTH.



LONGITUDINAL SECTION.

PLAN




29.0
3.3
82.11"
5.0
29.6
12 Treads

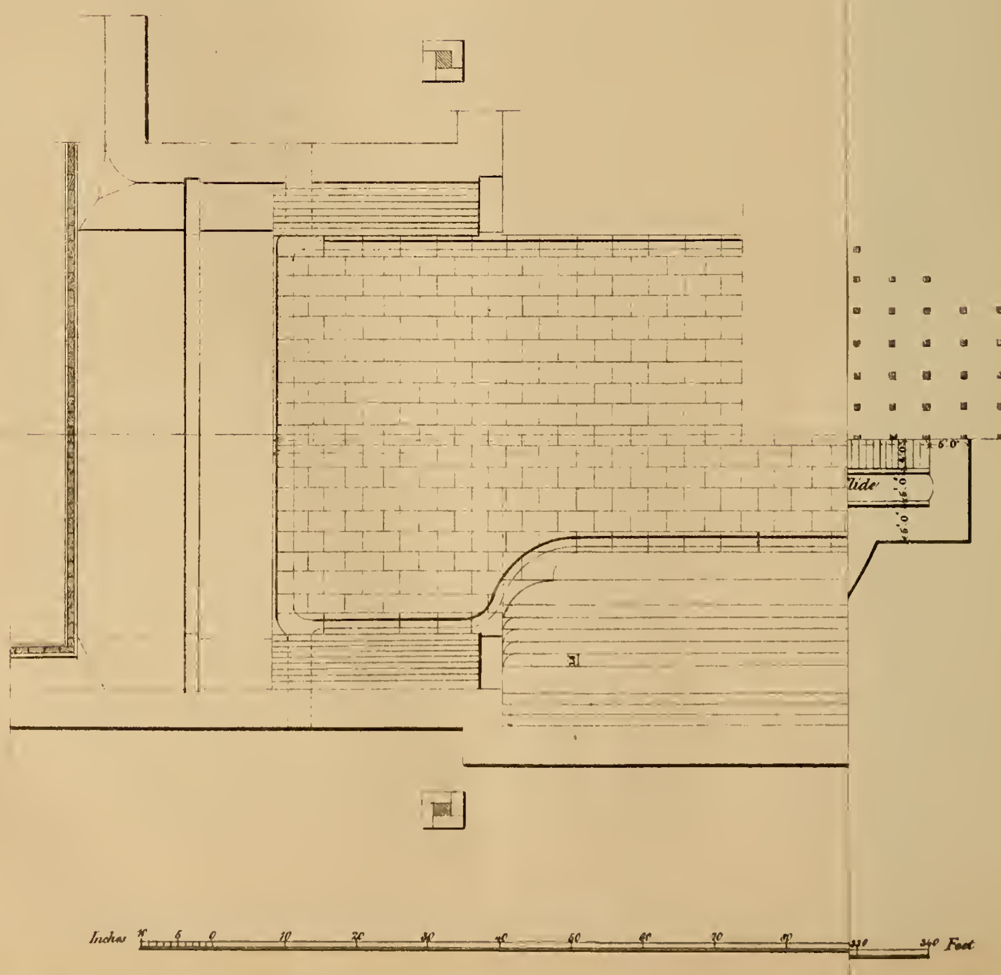

Slide
6.0
Inches
Feet

Fig. 1

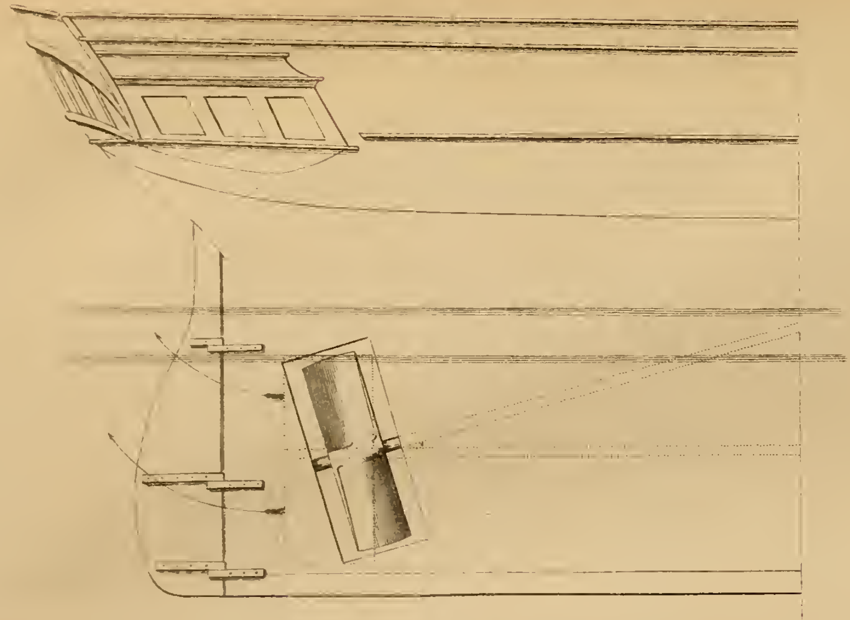


Fig. 2

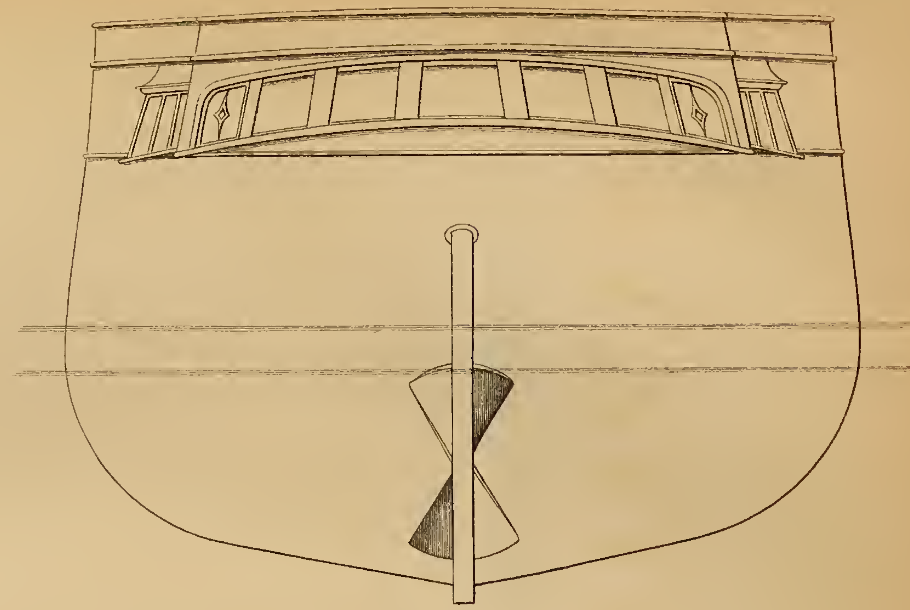
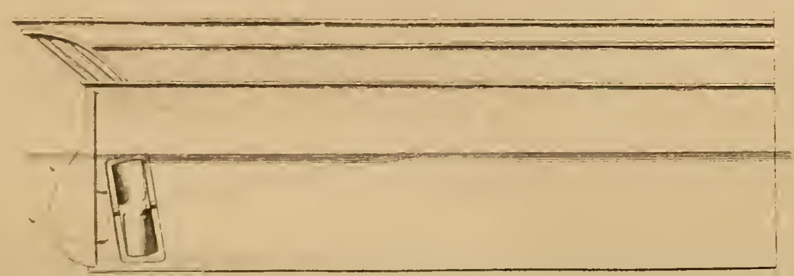


Fig. 3



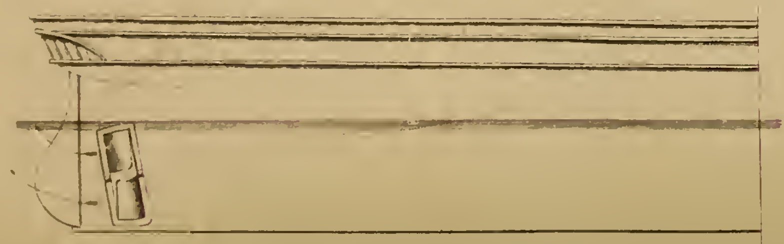
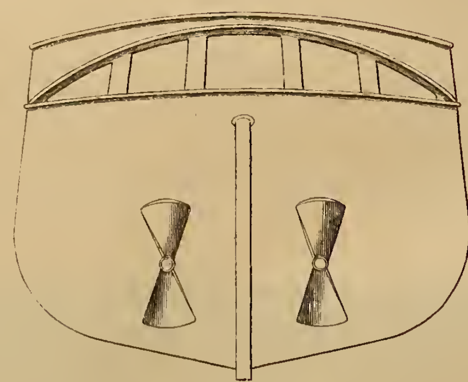


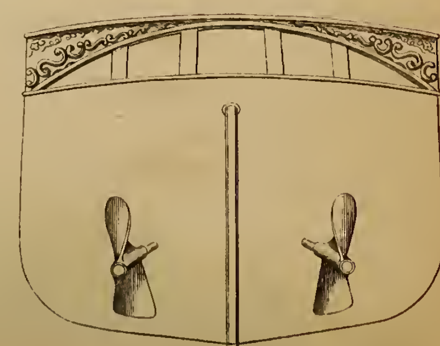
Fig. 4

Fig. 5



D. J. HOARES' *IMPROVEMENTS IN THE APPLICATION OF THE* SCREW.

Fig. 6



Engraved by C. Chabot.

THE ARTIZAN.

No. CLII.—Vol. XIII.—SEPTEMBER 1st, 1855.

THE PARIS UNIVERSAL EXPOSITION, 1855.

With the object of presenting to our readers accurate descriptions of the buildings and their contents in an agreeable form, briefly yet sufficiently, we have made such arrangements as will enable us to do so each succeeding month, and doubt not that the able assistance we receive from an eminent engineer, at present in Paris, and his treatment of the subjects, will be appreciated by our readers.

On the present occasion we give a slight sketch, preliminary to dealing with the mechanical and manufacturing parts of the Exposition,—those most likely to be practically serviceable to the majority of our readers; it being our intention to point out all that strikes us as novel and useful, and all that comes into comparison with what has been done in England and America; and we intend to confine ourselves, as much as possible, to professional and analytical treatment of the various subjects.

The Great French Exposition consists of two separate divisions—namely, the Palais de l'Industrie and the Palais des Beaux Arts. I shall now describe the situation and general arrangement of the first of these buildings.

The Palais de l'Industrie occupies a triangular space of ground immediately west of the Place de la Concorde. It is bounded on one side by the avenue of the Champs Elysées, and on the south side by the River Seine: the third side of the triangle is formed by the Avenue Montaigne, and the eastern apex of the triangle is the Place de la Concorde.

The Palais de l'Industrie is itself composed of three separate parts—namely, the Industrial Palace properly so called, the long gallery by the side of the river, and the junction passage which connects the Industrial Palace with the long gallery.

The external walls of the Palace are built of stone, partly of two varieties of oolite, and partly of sandstone; the internal divisions are of cast and wrought iron, and the roof is of glass. This principal building is the only one intended to be permanent: the long gallery and the connecting passage are to be taken down at the close of the Exposition.

The principal building is a rectangle, 656 feet in length, 164 feet in breadth, and 115 feet in extreme height, with a gallery on each side 79 feet in width. The gallery consists of two stories—namely, the ground-floor and the first story, these being equal in size. The upper galleries and the grand hall are lighted through the glass roof, and the lower galleries receive their light through more than two hundred windows opening on the Champs Elysées.

The upper gallery is supported on cast-iron columns, and subdivided into twenty-three bays or spaces of about 26 feet each. They are approached by six double grand staircases, distributed in different parts of the structure. Each of the staircases terminates in a pavilion, the principal of which are the north and south pavilions. The north pavilion contains the various reception-rooms, the drawing-rooms of the Emperor and that of the Empress, the apartments of the Director, and the offices of the Police and the Administration. This pavilion faces the avenue of the Champs Elysées, and forms the principal entrance to the Palace. The southern pavilion is on the opposite side of the building, where the connecting passage commences, and contains two grand staircases leading to the upper galleries. Four other pavilions, each with a double staircase, are situate in the north-east, south-east, north-west, and south-west corners of the building.

The grand entrance, on the north side, is surmounted by a group of statuary representing France in the act of crowning the statues of Industry and Commerce. On the right and left are groups of genii sustaining shields embellished with the cipher and armorial ensigns of the Emperor. Beneath the central group, and occupying the entire breadth of the great door, is a frieze representing Industry and the Arts coming to offer their products to the Universal Exposition.

The great central hall is occupied entirely by colossal objects belonging to all nations—such as fountains, equestrian statues, lighthouses, models of ships, &c.

The long gallery extends, by the side of the Seine, a length of 4,000 feet, and is 56 feet in height to the roof of the glass arch which covers it. One-half of this length has also a projecting passage on each side, which supports an upper gallery 23 feet in width.

The connecting passage proceeds from the south entrance of the Palace to an old building called the Panorama, which is now absorbed as an integral part of the Exposition; and after encircling this building, it passes on to the long gallery, which it joins at a very oblique angle, The walls of the connecting passage do not quite join those of the long gallery, the communication being made by a staircase passing over an archway which is built across the Cours de la Reine, in order to keep open this thoroughfare for the traffic of carriages and horses.

DISTRIBUTION OF SPACE IN THE PALAIS DE L'INDUSTRIE.

The entire northern half of the ground-floor is devoted to the productions of France; one-half of the southern side is devoted to Great Britain; and the remaining fourth of the ground-floor is shared in unequal proportions by the United States of America, Belgium, Austria, and Prussia. In the upper gallery, nearly one-half of the whole space is again devoted to the native industry of France; England again comes in for nearly one-half of the remaining space, or one fourth of the whole; while the yet remaining fourth is devoted to the productions of India, Egypt, Tunis, Turkey, China, Greece, Tuscany, the Roman States, Sardinia, Portugal, Spain, Switzerland, Holland, Sweden, Denmark, the Zollverein, Prussia, Austria, and Belgium.

The panorama and the passage of communication between the Palais de l'Industrie and the long gallery are entirely filled with the productions of France, which also occupy one-half of the whole space in the long gallery. Here, again, Great Britain has been allotted a space of at least one-fourth of the whole building, in which the magnificent display of machinery in motion occupies a considerable part. The remaining fourth of the long gallery is again shared by a host of nations, which follow somewhat in this order: — Canada, the United States, Spain, Tuscany, the Roman States, Portugal, Sardinia, Egypt, Turkey, Greece, Switzerland, Holland, Denmark, Sweden, the Hanseatic Towns, Prussia, Norway, Austria, Belgium, and Algeria.

THE NAVE.

The pavilions or trophies of different nations erected in the nave form a feature of great attraction in the present Exhibition. They are highly instructive as an index of national tastes and pursuits, pointing out in each individual case the branches of industry to which particular nations have directed their chief attention. While the whole Exhibition, viewed as the collective contribution of all, exhibits in one grand picture the goal and the results of national industry, these trophies, taken separately, mark in a more distinct and precise manner the separate road by which each nation has travelled to arrive at its present industrial position.

The space has not been sufficient to admit all nations into the great hall of the Palace. Five nationalities alone possess trophies there: England has ten; the United States of America, two; Belgium, three; Austria and the Zollverein, each three.

The trophies of England, as may well be anticipated when her colossal industry is considered, display by far the largest variety of manufacturing operations. One of her most remarkable trophies is consecrated to the native industry of Ireland—the manufacture of linen. Here we may trace the flax through all its stages—from the growing stalk laden with grains till the fibre is converted into thread, of which there are numerous specimens, both white and coloured. The Royal Society of Belfast has devoted much attention to this exhibition of products from the province of Ulster. Several manufacturers have added articles of embroidered linen—such as collars, the dresses of children, &c. Amongst these objects the display of table-linen claims particular attention.

Another trophy is dedicated to the metallic industry of Sheffield, in which the display of polished steel stoves, of a form and magnitude so entirely unknown in France, has been viewed with great admiration, and imparts to our neighbours what they call themselves "a magnificent idea of our domestic installations."

Two similar pavilions are erected in honour of the towns of Birmingham and Wolverhampton, which, with characteristic varieties, work like Sheffield, in iron and steel. Here Birmingham exposes her lamps, her lustres, her articles of copper rolled and cast, together with a large display of manufactures in papier-maché and lacquered iron.

The town of Wolverhampton, notwithstanding its rapid rise and its population of 80,000 inhabitants, has hitherto been little known amongst the French. The trophy in the nave is chiefly made up of ironmongery and models, which, according to the French, indicate amongst us "large conditions of existence;" while the other productions of Wolverhampton—such as the fabrication of locks, of japanned ware, and articles in brass and copper—are amply represented by individual exhibitors.

The trophies of the United States, in common with the whole of their exhibition, fall short of what was expected, and exhibit rather industrial pursuits founded on European notions, than manufactures of indigenous origin. Let us not infer from this, however, that the Americans are wanting in the energy suitable for industrial manufactures: it must rather be admitted that so many vast arenas claim its activity at home, that the American genius finds it more advantageous to introduce on its national soil certain modifications of foreign industry, than to seek distinction by purely indigenous manufactures.

The three pavilions of Belgium have, at first sight, a somewhat meagre appearance; but it is said that some decorations are yet to be added which will bring them up more to the level of other parts of the grand hall. The Belgian department is well furnished within.

Austria has nothing prodigal in her decorations, which are simple without being parsimonious.

Prussia and the Zollverein are much more sumptuously installed. The same crimson velvet daïs, bordered with friezes of gold, encloses the different States of the Confederation, and typifies the alliance which unites them. The Prussian is the richest of all the decorations, French or foreign, and is, besides, conceived in such a manner as to harmonise perfectly with the objects displayed in the interior of its pavilions.

SUPPLY OF WATER TO TOWNS IN FRANCE.

This subject is at present engaging almost as much attention amongst our good friends and neighbours the French as it is in our own country. Several projects of great importance are under the consideration of the Government and the municipality of Paris with reference to the supply of that city. Calais has been very imperfectly supplied for some years, and it is now said that the Artesian well which has been so long in progress, under the direction of M. Mulot, who made the famous Artesian boring at Grenelle, is to be abandoned, owing to the entire want of success in finding water. The well at Calais has already cost £3,560, and has been bored to the depth of 1,138 feet, of which 241 feet are in tertiary beds above the chalk, 762 feet are through the chalk, and the remaining 135 feet in beds below the chalk. To the great astonishment both of the French and English geologists, it was found, on passing through the chalk, that instead of the usual beds of greensand and gault which form the subordinate members of the cretaceous series, the succession was suddenly broken off, and the boring penetrated into what have now definitely been pronounced the grits and shales of the coal-measures.

Since the abandonment of the well at Calais, we understand the attention of the municipal body has been directed to the valuable springs of *Guines*, as a supply which would perfectly meet the wants of Calais without any risk of failure or disappointment.

The town of Guines is situate about six miles from Calais, and occupies that peculiar position in a chalk district which is represented in this country by such places as Croydon and Watford, where, it is well known, the springs of water rising from the chalk are exceedingly copious. These springs, in fact, break out at Guines just as they do at so many places in our own chalk district, on the line of saturation in the chalk, where that line cuts the surface of the ground, and where a depression causes the water to gush out of the overcharged beds beneath. So copious are these springs at Guines, that they not only supply all the inhabitants most abundantly with water, but they fill all the large dykes and marsh drains of the Pas de Calais, and also feed and keep up the supply of the canal which passes from Calais to Guines, and ramifies in every direction through that level district, which here separates France from Belgium. It is said that sufficient water for the supply of Calais can be taken from the springs near Guines, without in any way injuring or interfering with the supply to the latter town.

The smaller towns in France, as long as they can procure a supply from wells, or even from public springs or fountains, seem quite content with this kind of drudgery; although, in many cases, it would cost less than 20s. per head to raise the water to an elevated reservoir of sufficient height to supply the upper story of every house in the town. A work of this kind would save not only the constant labour and drudgery of raising and carrying the water by hand all over the town and to the tops of the houses, but would afford the means of immediately extinguishing fires, in place of depending on the miserable exertions of firemen, who are commonly inadequately supplied with water, and cannot procure it in sufficient quantity, even if they possess the means of pumping it. This complaint of dilatory inaction, although it applies with too much force to many small towns in England, has certainly been somewhat remedied of late years; and were it not for the pressure entailed by the unfortunate war now in progress, we might confidently hope to see more vigorous steps taken by all towns to improve their supply of water.

SUPPLY OF WATER TO BOULOGNE.

The district around Boulogne is geologically similar in structure to that in the neighbourhood of Hastings. The town stands at the mouth of the small river Liarre, being principally built on the sloping ground of the right bank. The strata exposed in the cliffs on each side consist of thick alternations of clay and sand, the latter of which yield copious springs of water where they are supported by the more impermeable masses of clay.

Water is abundantly met with in sinking down a few feet in any part of the town, the water standing only a little below the surface of the ground in the private wells; and besides these, there are numerous public fountains, where the inhabitants are allowed to take the water for themselves and carry it away without any charge. In addition to this natural supply of spring-water, the French are remarkably careful to collect every drop of rain-water which falls. For this purpose, every little roof, however insignificant in extent, is provided with pipes and gutters to collect and carry the rain-water, chiefly into underground cisterns, from which it is pumped up by manual labour to the upper floors of the best houses. The fuel which is burnt for domestic purposes being chiefly wood and charcoal, the atmosphere is never charged to any great extent with the disgusting carbonaceous matter, in the form of "blacks," which so distinguishes the atmosphere of London, and of most large English towns; and it follows as a necessary consequence, that the rain-water in France can be collected in a state of great comparative purity.

Many of the public fountains appear to be supplied in the same way as the ancient conduits of London; namely, by small streams of water conveyed in pipes from the heads and sides of valleys, where they break out as springs.

ON THE OCCURRENCE OF COAL-MEASURES BENEATH THE CHALK OF CALAIS, AND THE PROBABILITY OF FINDING COAL BENEATH LONDON AND THE SOUTH-EAST OF ENGLAND.

It is remarkable that the boring for water at Calais is situate in the immediate neighbourhood of a disturbed district, surrounding Ferques and Marquise, where the coal-measures and other Palæozoic rocks not only come to the surface, but have been profitably worked for many years; in fact, the occurrence of coal-measures immediately beneath the chalk at Calais, coupled with the known circumstance of their occurrence beneath the oolites of Ferques, Marquise, and Hardinghen, has given rise to some speculations of the highest geological interest. For many years the French geologists had sought for the prolongation of the great Belgian coal-field of Liege and Mons in the direction of Arras, and many are the unsuccessful trials for coal which have been made in that neighbourhood. It now appears clear, however, that the great axis of elevation which has raised the Belgian coal-measures, has changed its direction at Douai from west to north-west, and that it ranges through the Bas Boulonnais district, crosses the channel to Hastings, causing the elevation of the whole Weald of Kent and Sussex, and the disturbances in the Isle of Wight, and passing on to the West of England, where Palæozoic rocks and their accompanying coal-beds are again brought to light in the coal-basins around Bristol and in South Wales. These facts, now well established in connexion with the true range and direction of this great axis of elevation, have given rise to a very bold suggestion, which was discussed by the Geological Society at one of their recent meetings. This is no other than the probability that coal may be found at no very enormous depth in the Weald of Kent, or even possibly beneath London itself. The geologists who have most warmly advocated this idea, have supported it by reference to some recent deep borings in the Isle of Wight, in which fragments of igneous rocks have been brought up. It is also said that the late Dr. Mantell had a collection of granitic pebbles, and other plutonic and volcanic rocks, from the Weald of Sussex. It was argued that the occurrence of such pebbles on the surface went far to prove that igneous rocks might occur *in situ* at no great depth, and it was probable that the older stratified rocks would be found accompanying such eruptions of ancient igneous rocks as that which was here indicated. Of course, no human being can pretend to say at what depth the coal formation might occur beneath London or the southern counties of England, or whether it would occur at all at any depth suitable or profitable for working; yet who knows or who shall pretend to affirm the contrary? Persons who are imaginative may well be excused the speculation, nor deemed absolutely madmen when—backed by such geological evidence as we have now obtained—the idea of procuring coal beneath London presents itself as one not altogether absurd or impossible.

PAVEMENT FOR FOOTPATHS.

The neighbourhood of Boulogne abounds with valuable marble and building-stones; but there is nothing which resembles the flag or paving stones that occur in most of the British coal-fields, and supply so excellent a material for the structure of footpaths. The French footpaths were, until a very few years, almost universally unpaved, and were commonly in a miserable condition during wet weather, being worn into holes, and variegated by innumerable patches of mud and puddles of water. A great improvement has been introduced in this respect during the last few years. Many of the footpaths in the principal streets of Boulogne are now formed of squared slabs, about 12 inches square, of black and white marble, disposed alternately, like the squares of a chessboard. The marble is not polished, but only dressed to a smooth surface: it looks exceedingly well, forms an excellent footpath, and being bedded on *béton*—a description of coarse concrete—is in better condition and has a more uniform surface than many of the flagged footways in London. Another method adopted here consists in the use of small square sets or blocks of limestone for the footpaths. These small blocks or cubes are dressed to a uniform size of about five inches each way, and are carefully laid on concrete and jointed close with good strong mortar. The joints are not at right angles to the line of street, but diagonally, so that the surface presents a neat and tasteful appearance. This kind of footpath wears exceedingly well, as, the joints being filled up flush with mortar, no moisture can penetrate, and the stones are consequently protected from the injurious action of frost, &c. The small cubes of stone are not dressed with a chisel, like the larger chessboard squares, but are merely picked or dressed with the point of the mason's pick; but the slight roughness is rather an advantage than otherwise, as the pavement never assumes that greasy, dirty condition which is so often observed in the London footways.

These expedients of the French are not pointed out as worthy of imitation in London or other large towns where Yorkshire flags can be procured at a reasonable rate; but in many parts of England, where none but stones of small scantling are procurable, the method of forming footways with small squared paving-stones might be used with considerable advantage. The formation of the path with small squared stones is a great improvement on the old method of paving with rounded pebbles or boulder stones, as one sees in any of the old French and not a few English towns. Nothing can be more uncomfortable to walk on than a pavement formed of round stones; in addition to which, the surface is generally in very bad order, and very full of hollows, which allow the lodgment of water.

NOTES BY AN ENGINEER ON THE PUBLIC WORKS OF FRANCE.

IMPROVEMENTS IN THE PORT AND TOWN OF BOULOGNE.

A handsome swing bridge has been built across the Liarre, just above the line of quays, and in front of the terminus and station of the Chemin de Fer du Nord. There are three water-ways through the bridge, one of which, 40 feet in width, is appropriated for large boats, and is provided with an ordinary tidal lock and gates, so as to admit the passage of boats when the water in the river is at a different level from that in the harbour outside. The other two water-ways are each about 21 feet in width; and one of these is fitted with a single lock-gate, which swings on a vertical axis, and admits the passage of small boats not more than about 10 feet in width. This contrivance, which is technically termed the balance-gate, is much in use in the navigation of Holland, and might occasionally be employed in England with advantage. As the gate swings, not on an ordinary heel-post, but on an axis which is fixed in the centre, it is evident that under any head of water the pressure is equal on each side of the centre. Hence, in order to open the gate, it is only necessary to overcome the friction of the gate itself; so that a very small power is sufficient to open the gate, whatever be the difference of level on the two sides of it. The line of quay in front of the barracks, above the swing bridge, is formed, not by upright walls of dressed ashlar, as commonly used in England, but by a stone wall, with a slope towards the water of 45°, or about 1 to 1. I have not seen the back of this wall exposed, but presume it is formed chiefly of concrete, with ashlar masonry in part.

The neighbourhood of Boulogne abounds with good building-stone of several descriptions. First, there are the oolites of Ferques and Marquise, resting on the carboniferous limestones and other members of the Palæozoic series, and then a succession of limestones and grits, which afford building materials and even ornamental marbles in considerable variety. The marbles vary from shades of light grey through every gradation of brown to a shade almost black. They are extensively used in domestic architecture, as for jambs and chimneypieces, also for gravestones and other sepulchral ornaments; while many monuments and other works in the neighbourhood, such as the famous Napoleon Column, &c., are built of the marble of Haut Barre, and that from the Carrière Napoléon. The Boulogne Museum contains a good collection of the various marbles and building-stones, to illustrate the economic geology of the district.

It appears that M. Marquet's plan for the construction of a dock on the west side of the harbour is still in abeyance, the project being somewhat more extensive than the resources of the town will justify at the present moment. The first Napoleon, when he contemplated the invasion of England, constructed a boat-harbour of considerable extent, by excavating the *dunes*, or sandhills, which flank the western side of the port; and M. Marquet's idea was to convert this old boat-harbour, which is now rapidly filling up from natural causes, into a wet dock. He proposed an entrance provided with locks, and communicating with the tidal harbour of the Liarre, and contemplated the construction of a semicircular line of quay-wall, and the erection of extensive warehouses and depôts for food. This attempt to construct docks, and thus add to the commercial importance of Boulogne, will probably be carried out at no distant period; and there are few places on the French coast which appear to possess greater natural advantages than this favourite sojourn of the English.

It is interesting to trace, from one of the neighbouring hills, the gradual enlargement of the town, and to observe the immense aggregation of buildings which surround the old nucleus planted on the top of the hill commanded by its citadel, and surrounded by its ramparts and embattled walls. It is probable that in the time of the Romans, when Caligula built the tower which still retains his name, Boulogne was little more than a hill fortress; and it is certain that as late as the fifteenth century, all the lower or more modern part of the town, comprising the Rue de l'Ecu and others of the best streets, was a low, marshy island, separated from the main land and from the ancient walled town by a narrow creek connected with the Liarre. In process of time, the buildings outside the walls not only extended on each side down to the edge of the water, but the creek became covered over and the whole island built upon, so that no trace of its original insular character now remains. It appears to have been a miserable place in 1800, when Nelson is said to have spared a bombardment out of compassion for the poverty of its inhabitants. How different is its aspect to-day, and how little the observation of poverty would apply to the rich and showy shops, in which French elegance seems to emulate and vie with the more substantial displays of the English trader, I need scarcely say to those who have lately visited this more than half English town.

I must not omit to notice one feature to which the French pay particular attention, and which I may illustrate by an instance which occurred to me in Boulogne. Is there a commanding site in a town, on which some towering structure is to be erected? The French do not bury, conceal and try to plant it out, and destroy the effect in a hundred different ways; but they strive by every means to bring out the beauty and grandeur of the object, be it church or citadel, tower or castle. Thus, the effect of a very handsome church which is being erected in a most commanding position of the Old Town, is wonderfully heightened by about a mile of the high road to Paris being in a direct line, pointing towards the magnificent dome of the church, which appears at the end of a long vista with an effect which greatly heightens its real value as an object of interest to the traveller who gazes upon it. Innumerable instances of this kind might be noticed, where the French seize with an extraordinary appreciation of fitness, grace, and elegance every natural advantage of this kind which can be brought to bear in aid of their architecture.

A handsome *abattoir* has been erected just outside the town, on the Paris road; and here, under the supervision and careful management of the superintendent, all the slaughtering of the town is conducted, and the residents and visitors relieved from the immense nuisances of butchers' slaughtering-houses, with all their abominations, in close proximity to their dwellings. An air of extreme cleanliness and order reigns throughout the *abattoir*, and one cannot help being struck with the advantage which the system presents over the custom of slaughtering which prevails in most English towns.

In the matter of sewerage most French towns are much behind ourselves. The cart of the scavenger is still in requisition to remove the *rejectamenta* from every house, and the gutters still run with a vile, polluted stream, which disgusts both the senses of seeing and smelling. In truth, the two countries might learn much from each other, and it is not just to suppose that either has the advantage or superiority in all things. Let it be borne in mind that the French are before us in two most important sanatory points; namely, that they bury their dead and slaughter their animals outside the towns, and far from contact with their living inhabitants.

PRACTICAL PAPERS.—No. V.

ON DESIGNING MARINE WORK.

In a previous paper, we stated that the greatest length that a shaft might be made ought not to exceed 30 feet, as, under ordinary circumstances, a greater length would cause inconvenience in shipping, and subsequent handling in the confined space allotted to the "shafting" of a screw-steamer. But there is another point to be considered in practice:—allowing that a "line" divided into moderate lengths is equally efficient with one composed of long shafts, does the cost to the constructor remain the same in both cases? We find, on inquiry from makers, that the forgings of, say two shafts, of 15 feet in length, weighing less than 30 cwt. and more than 20 cwt. each, will cost 15 per cent. less than one shaft of the same diameter 30 feet long. It may sometimes happen that the cost of the additional pedestals and supports necessitated by this otherwise economical subdivision of the shafting is such as to render it unadvisable; but as the practical estimate of the constructor's skill is formed from the "effect" he produces with a given amount of money, he may find his account in making the two arrangements on paper, duly considering the respective advantages.

We cannot pretend to give the actual price of work of this description, as it depends upon so many accidental circumstances—localities, money-markets, accommodations between particular houses of business, &c.; but as an approximation to and illustration of the subject, by which our readers may check their particular information, we have drawn up the following Table, giving, generally, the cost per cwt. of wrought-iron shafting, plain and flanged, and the weights of certain sized shafts, sufficiently accurately for reference :—

	Flanged.	Unflanged.	A Shaft, 12 feet long, to weigh	Is in diameter, in inches, nearly
	s. d.	s. d.		
Under 5 cwt.	21 0	17 0	5 cwt.	4¼
Above 5 cwt. to 10 cwt.	26 0	22 0	10 „	6
„ 10 „ 20 „	28 0	24 0	20 „	8½
„ 20 „ 30 „	30 0	26 0	30 „	10½
„ 30 „ 50 „	32 0	28 0	50 „	13½
„ 50 „ 100 „	34 0	30 0	100 „	19

It is not necessary to examine into the cause of this apparently arbitrary increase of price at present; but whilst stating what we believe to be the average cost of plain, flanged, and unflanged shafts at this time, we may also remark, that any considerable boss or projection of the shaft adds considerably to the expense of making it.

Fig. 1 represents the wrought-iron flanged coupling now in very general use; and the reason for reducing the projection of the flange so as just to leave width enough for the nut to bed upon, is found in the objection raised by the forgeman to making any considerable boss or projection on a plain shaft at an inconsiderable increase of price. If we use this form of coupling, then it is desirable to make it as small as may be consistent with strength, bearing in mind that the increase per cwt. is charged on the whole length as well as on the *material* of the flange: and, for the above reasons, the greatest accuracy must be used in obtaining the lengths of the shafts, as little allowance for "turning off"

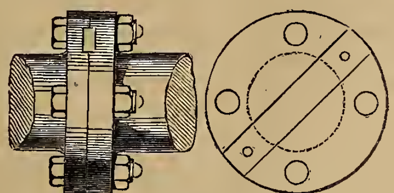


Fig. 1.

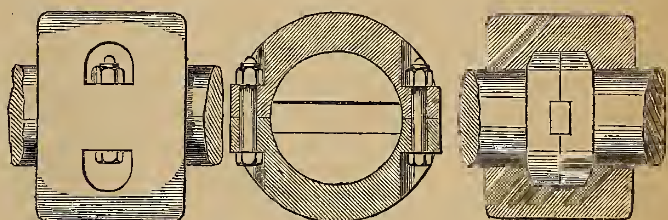


Fig. 2.

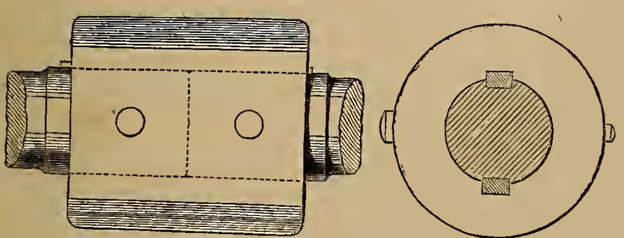


Fig. 3.

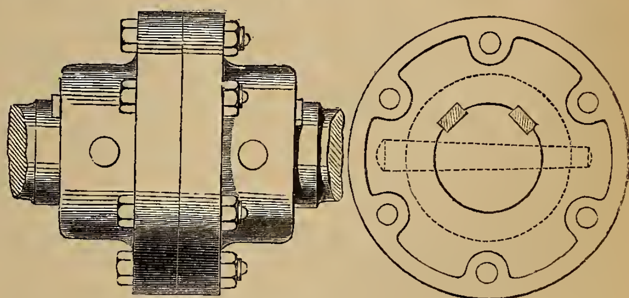


Fig. 4.

can be made in this variety, compared with what might be made if such couplings as shown in Figs. 3 and 4 were used.

The design shown in Fig. 2 had for its object principally the reduction of cost of the flanged shafts, at the same time retaining the advantages of solidity and compactness, the forgings being cheaper, inasmuch as the projections at the ends of the shafts are less in diameter, and half an inch in this dimension makes an appreciable difference in the cost.

A coupling may be generally defined as a block or blocks of metal inserted between two contiguous shafts, so shaped and fitted as to transmit power from one to the other, just as would be done supposing the two contiguous shafts in one piece. Let us then see which of the given varieties most closely imitates the solid junction. Taking Fig. 1 first—it is superior to those shown by Figs. 3 and 4, inasmuch as when the engines are turned "astern," all the material of the solid shaft is thrown into strain; whereas, in Figs. 3 and 4, the pins only in the bosses are available, the bolts merely passing the pull from the after to the forward pin. Thus, the bolts in Fig. 4 may be said to be passive, in contradistinction to the bolts as used in Fig. 1, which have an active duty to perform.

As to the thrust in the first and second varieties, it is received on the flanged ends at once; but in the third and fourth, it is thrown upon the pins. As to the pull, the bolts in the first instance perform the same duty as the cast-iron case in the second; in the third and fourth, the pins in the bosses again sustain the whole wear and tear. As to the driving power of these couplings, the first and second drive from the key inserted between the ends, the third transmits the transverse strain through two feathers fitted into the shafts on which it slides, and the fourth drives by means of the bolts in the flanges, primarily from the keys in the shafts. The keys in this last coupling are placed 45 degrees asunder, both to clear the pins passing through the bosses, and to draw the boss close to the shaft. If they were placed opposite to each other, in driving them into their places, there would be a tendency to force the boss into an oval shape. In old times, there was so much wear on couplings, caused by loose fitting, that it was found advantageous to oil them, their durability being thereby much increased. With modern appliances properly handled, we know no reason why the first form of coupling, shown above, should not last for ever, if, instead of oiling it, care be taken to keep the bolts always screwed hard up; and it might be found a good thing in practice, to distribute the bolts unequally in the flange, bringing one on each side close to the key; which arrangement would increase the effect on the key of screwing them up. Of the four mechanical combinations given, we think the first most closely imitates the solid junction. As a coupling, simply, we should decidedly use it in preference to the others.

In general, the marine engine is a far more powerful machine than the mill engine: its work is more irregular, and its whole power is passed through the one connexion. In mill-work, the power of the smaller engine is communicated by numerous connexions, and at a regular speed. We may, then, distinguish the connexions of marine-engine shafts as *high-pressure couplings*, those of mill-work generally as *low-pressure*; and, as such, too great care cannot be taken in the fitting and execution of this description of marine work.

Where first cost is not considered in the first place, and in vessels manned, as in the Royal Navy, with crews sufficiently numerous to meet almost any demand for "hands," the propeller is usually fitted in a costly and cumbrous frame, by which it is raised out of the water.

The question as to the desirability of making the propeller in such a manner that it can be disconnected from the shafts and raised out of the water is no longer open to discussion, so far as theory can decide it. But a desirable method of so doing, combining moderate first cost, economy in use and subsequent stability, is a *want*, which we attribute to a want of distribution in Government orders. Most of our readers, we doubt not, are familiar with the lists of steam-ships in Her Majesty's Navy, and the significant column headed "Name of maker of engines." We have heard of orders for engines being given by the *dozen* to eminent firms on the Thames: this may be exaggeration; but though fully admitting that the excellent designs executed there have raised the standard of marine engineering, and improved the practice of the country indirectly, yet we should wish to see the public money directly developing the talent of the "country." At present a great name obtains the greatest gain: we humbly suggest to the authorities, that though these sons of Kish may tower above their professional brethren in reputation, yet smaller men may be found worthy of employment now and then.

ON TESTING THE QUALITY OF BUILDING-STONES.

Two very opposite methods have been adopted for this purpose,—the one a purely mechanical test, and the other a test by means of chemical analysis. The advocates of the first defend it on the ground, that as the destruction of stones in buildings is due entirely to atmospheric agency,—that is, to the alternate and slow action of heat, frost, and moisture,—the best mode of testing the capacity of the stone to resist these, is to subject it at once to a violent and concentrated action of frost succeeding a state of moisture; and this trial, being much more intense than that which takes place under natural circumstances, is thought by them to afford a fair criterion of the value of the stone. To effect this trial, after first accurately weighing the specimen, they saturate it with as much water as it will absorb, and then surround it by a freezing mixture, so as so envelop the whole in a mass of artificial ice, leaving it in this state for twelve or twenty-four hours: the specimen is then taken out, cleaned, washed, and again weighed; the amount of weight lost by the freezing process being the measure of the effect produced. Such is the process introduced by Brard, the celebrated mineralogist, and subsequently acquiesced in by the first authorities.

Others contend that the mode of testing by chemical analysis is preferable, and require to inform themselves of the exact percentage of lime, silica, alumina, magnesia, potash, &c., which every specimen contains. Now, it happens, unfortunately, that many specimens which have been so treated, although known to be of very different value as building-stones, contain precisely the same earths, occurring, too, nearly in the very same proportions, and there is little or nothing in the chemical analysis to distinguish the good stone from the inferior. It follows that this kind of examination would be perfectly useless in the case of comparing untried specimens. Indeed, when we reflect on the widely different circumstances under which the ingredients of rocks have been aggregated, there appears in this abundant reason for the different qualities of stone produced, even when those ingredients are precisely the same, and in the same proportion. Take the case of the igneous rocks, such as granite, trap and porphyry, and mark how the mode of crystallisation affects the quality of the stone. The crystals in one case may be large, distinct, and possessing little adherence amongst themselves; in another, the very same ingredients may have crystallised in a close, compact, and solid form, producing a stone infinitely superior to the other, although analysis shows it to be composed of precisely the same ingredients. We know how firm and compact is much of the granite in Cornwall and Devonshire, while the very same granite within a very short distance is in a state of complete decomposition, and furnishes large tracts of aluminous earth from the destruction of its felspar. Sir Charles Lyell* mentions in America extensive masses of gneiss actually decomposing *in situ;* and although to all appearance firm and solid, yet the crystals of felspar, whilst retaining their angles in pieces eight or ten inches long, are found on examination to be mere soft alumina. And yet this soft and perishable rock would give the same results to chemical analysis as the most solid indurated gneiss or stratified granite. Again, take the case of sedimentary rocks, where the mode and rate of aggregation, and the amount of pressure acting on them while still more or less plastic, must have materially influenced the quality of the compound. In most sedimentary rocks there is cementing paste or matrix by which harder grains are aggregated together, and it is the paste which usually yields to atmospheric influences. The quality of this paste, whether crystalline or earthy, calcareous or silicious, is of very great consequence; but it may, with the very same ingredients, be either crystalline or earthy: so that here, again, chemical analysis will fail to detect the quality of the stone from its constituents. In fact, the result of some very recent experiments, by some of the able chemists attached to the Geological Survey of Great Britain, on several varieties of oolitic and magnesian limestones, which varied much in quality, was to show that very little chemical difference existed between varieties of the same stone; and they could point to nothing which indicated so strongly the difference between them as the nature of the cement, whether crystalline or earthy.

* Lyell's "Second Visit to the United States," vol. ii. page 22.

DESCRIPTION OF CAISSON FOR THE SOUTH INLET DOCK AT H.M. DOCKYARD, PORTSMOUTH.

In continuation of the subject of Caissons, we have the pleasure of presenting to our readers another illustration of the application of these useful substitutes for hanging gates, for closing wide openings to docks.

Plate li. illustrates the wrought-iron caissons designed by Mr. Wood, Clerk of Works, Portsmouth Dockyard, for closing the entrance to the South Inlet Dock, a description of which dock we gave last month, when noticing its completion and opening, at pp. 154, 155.

On reference to our description of the wrought-iron caissons for Her Majesty's Dockyard, Keyham, pp. 73, 74, and 97, 98, illustrated by Plates xxxiv. and xxxvi. (1855)—the letters and remarks on the late Sir Samuel Bentham's claims, as having first suggested the use of such means for the purpose of closing dock entrances, as also the description of the Sheerness caissons, illustrated by Plate 50—the differences between Mr. Wood's caisson and others will be understood.

The cost of this caisson is about £4,500.

The dock can be filled and the caisson floated out in about thirty minutes; and the caisson can be swung, replaced, and sunk in ten minutes.

The following description of the caisson will suffice to make the drawing (Plate li.) perfectly understood.

The sheathing-plates are $\frac{1}{2}$ inch, $\frac{7}{16}$, and $\frac{3}{8}$ thick, divided into three equal spaces from the bottom.

The $\frac{1}{2}$-inch plates are double, and the remainder single rivetted. All the rivets are spaced 3 inches from centre to centre. In the double rivetting, the rivets are arranged opposite to each other transversely to the joint.

The keel is of plate-iron, 2 feet wide and $\frac{7}{8}$ thick; the lower strake of the sheathing turned down and rivetted to the keel in the firmest manner.

The T iron which forms the frame of the vessel is $3\frac{1}{2}'' \times 4\frac{1}{2}'' \times \frac{1}{2}''$.

The vessel is crossed by three tiers of beams—namely, one set to support the roadway, one for carrying the deck on which the pumps are worked, and the other 14 feet above the keel.

The roadway beams are made of $\frac{3}{8}$ plate, 7 inches wide, having double angle-iron on the top edge, $3'' \times 3'' \times \frac{1}{2}''$; the bottoms of the beams are strengthened by a rectangular bar of iron, $2\frac{1}{2}'' \times \frac{3}{4}''$, and strutted with 4-inch T iron to each beam.

The beams which support the deck on which the pumps are worked, are formed of single angle-iron, $3\frac{1}{2}'' \times 3\frac{1}{2}'' \times \frac{7}{16}''$, with the exception of those immediately under the pumps, which are the same as the roadway beams. The lowest tier of beams are of the same dimensions as those for the carrying the roadway.

Tie-rods of $1\frac{1}{2}$-inch iron are fixed to each alternate frame, 2′ 6″ apart: to these frames no deck-beams are attached.

Two ranges of these tie-rods are fitted, one at 5′ 6″ above the keel, the other at midway between the second and third sets of beams. Another set of these tie-rods are fixed 10′ above the keel to every 4″ frame, or 5 feet apart. Alternately between these, bars of angle-iron, $3\frac{1}{2} \times 3\frac{1}{2} \times \frac{1}{2}$ inch, are fixed and securely rivetted at the ends to the frames of the vessel.

Binding diagonal plates, 4 inches wide by $\frac{3}{8}$ thick, are fixed on the top of the upper set of beams, for securing the roadway planking.

Two circular culverts for filling the dock, of $\frac{3}{8}$ iron plates, are carried through the vessel at a height of 7 feet above the keel, each having an area of 3 square feet; they are fitted with sluice-valves, faced with gun-metal. Two sluices, having an area of 144 square inches, are fixed on the sides of the culvert for admitting water to *sink* the caisson. These sluices are fitted with apparatus for opening and shutting them, and are worked from the pump-deck. The caisson is ballasted with 102 tons of pig ballast.

Two pairs of 12-inch pumps are fitted to pump out the water when required to float the caisson; but it seems to us that there is one suggestion which we can make beneficially—that is, that Mr. Wood should move the proper authorities to have a small high-pressure boiler, which would only occupy a space of about 6 feet high by 3 feet diameter, and with a small cylinder attached to his pumps, he would be enabled to pump out and float his caisson without manual labour. This would, as it appears to us, make his apparatus perfect.

THE WAR, AND WHAT CLASSES OF VESSELS ARE MOST REQUIRED FOR ITS VIGOROUS PROSECUTION AND SPEEDY TERMINATION.

Since writing our remarks upon the approaching launch of H.M. steam-ship *Marlborough*, in our number of the 1st August, we have reflected upon a question raised in our minds some time ago by reading the following in the "Times" of the 12th July:—"The Russians, it is reported, adds a letter from the Baltic, have two gun-boats of formidable armament, for every one which the Allied Fleet have out here at present."

Fully alive to the exigencies and requirements of the war we are now engaged in, we have seen, with deep regret, how very reluctantly the *Executive* have entered into the spirit of carrying it on with energy and vigour. We feel half inclined to charge the Government with being either ignorant or wilfully blind to the immense material resources of this country.

We are wasting our energies in building immense line-of-battle ships. These ships require immense sums of money to fit them out, and large bodies of men to man them; while the cry from the Admirals of our Fleet—from every one who takes a common-sense view of the subject—is for more gun-boats, and for vessels of light draught of water.

It is insinuated—but that we cannot credit—that the resources of the country are, so far as the manufacture of steam machinery is concerned, limited by the Admiralty to the charmed number of three manufacturers.

We know the engineering resources of the country well; and we do assure the Government that *there are* many engineers of high standing, on the banks of the Thames, on the Mersey and Clyde, who would be too glad to be allowed an opportunity of employing their talents, and the immense mechanical resources at their command, in aid of a vigorous prosecution of the war, and who could, in a very few months, produce what is most required—a Fleet of Steam Gun-boats, of much lighter draught of water, and otherwise more suitable to the requirements and exigencies of our naval operations, more particularly in the Baltic.

TRIAL OF AGRICULTURAL IMPLEMENTS AT TRAPPES, NEAR VERSAILLES.

The Great Exposition in the Champs Elysées has attracted an immense collection of agricultural implements, in which the manufacturers both of Europe and America are represented. There are exhibitors from England, France, Prussia, Austria, Sardinia, and Sweden; while, from the other side of the Atlantic, the United States and Canada have contributed their share. It was with no ordinary enthusiasm, therefore, that the announcement was received that a grand trial of skill was to be made, under the superintending inspection of Prince Napoleon, at Trappes, a few miles beyond Versailles. This is not so much a trial between the implement-makers of one country, as a contest between different nations; and hence the individual makers have agreed to blend their common interests, and put forward the best implement of its kind, in order to support the national credit.

In the trial of tillage implements, which took place first, the ploughs by Howard, of Bedford, and Ransome, of Ipswich, were conspicuous for their elegant forms, their lightness of draught, the beauty of their workmanship, their excellent performance, and their comparatively moderate price.

Machines for making draining-tiles, steam-engines for farm-work, thrashing-machines, and chaff-cutters, were successively tried, but no award of their respective merits has yet been pronounced.

The trial which excited the greatest interest was that of the reaping-machines; and here the palm of eminence was hotly contested between M'Cormick's machine and that of M. Cournier, a native manufacturer, much distinguished for his mechanical skill and scientific attainments. The French implement had the merit of being the lightest, and perhaps the best finished, of the two; but the judges, after a very patient and observant trial, pronounced the implement of M'Cormick to be superior.

The reapers were afterwards tried in a field of lucerne, but the performance was not so good as with the corn-crop. The difficulty of reaping corn-crops by machinery seems perfectly solved, and we have only to look forward to improvement in individual machines, which all act on the same general principle of sawing off the dry and ripe stems of the corn. It is different, however, with the green crops, in which the stems do not afford the same resistance as the stalks of the corn-crops; and hence the action of the reaping-machines is by no means perfect in such crops, and it is questionable whether the present construction of the machines is adapted to this purpose.

The French appear to be excessively delighted with the display of agricultural implements which their Grand Exposition has drawn together, and they hail with great delight the prospect of improvement held out by the recent trials in the field at Trappes. They feel that their agricultural machinery is far behind that which is used for manufacturing purposes, and they look on such a trial of skill as that which has recently taken place, as one of the very best devices for stirring up the manufacturers of agricultural implements, and leading to improvement.

Trial of Drainage Implements.—Specimens of drainage were executed by M. de Beyas (France), and M. de Rongé (France); and a collection of drainage tools was exhibited by Burgess and Key (England).

Implements of Cultivation.—The following are the manufacturers whose ploughs were selected for trial:—Ball, Howard, Ransome (England); Grignon, Armelier, G. Hamoir, Bonnet, Parquin, André Jean (France); Metzaros (Austria); Friedrikswerke (Denmark); L. Morse (Canada); Hohenheim (Prussia); Van Maele and Odeurs (Belgium); the Academy of Ulturaa (Sweden); Ridolfi and Lambruschini (Tuscany).

A French cultivator competed against those of Bentall and Coleman.

A set of harrows by Howard was submitted to trial; also the Norwegian harrow, and the rollers of Cambridge and Hanley.

Thrashing Machines.—Six labourers, thrashing with the flail, were tried against machines by Clayton (England); Page and Co. (Canada); Pitts (United States); Damey, Duvoir and Parit (France).

Seed Drills.—The drills which were tried were those of Hornsby and Garrett (England), and of Haine-Saint-Pierre (Belgium).

Horse Hoes.—Those of Smith and of Garrett (England) were tried against those of Gustave Hamoir and Bodin (France).

Reaping Machinery.—Six reapers with the scythe tried their prowess against the machinery of M'Cormick, Manny and Wright (United States); Cournier (France); Dray and Burgess, and Key (England).

Haymaking.—The machines tried in this work were the hay-rakes of Howard (England), of Grignon (France), and of Count Morelli (Sardinia), with the haymaking machine of Smith (England).

Miscellaneous Machines.—Amongst others, a trial was made of the chaff-cutter by Van Mach (Belgium); the root-cutters of Ransome (England); the churn of Claes de Lambeck (Belgium); machines for making draining-tiles, by Madame Champion (France), and by Whitehead (England); of locomotive farm steam-engines, by Calla (France), and by Clayton (England).

The preceding experiments were made on the 14th of August, and the award of the judges is anxiously expected by the various competitors.

THE LIGHT-DRAUGHT GUN-BOATS OF THE IMPERIAL RUSSIAN NAVY.

The following particulars have been communicated to us by a Correspondent in Germany, a practical engineer, who was employed for some years in the Government establishments and private works for manufacturing steam and other machinery in St. Petersburgh. Being an Englishman, he left the Russian service, throwing up a very lucrative appointment rather than remain in the employ of the enemies of his country.

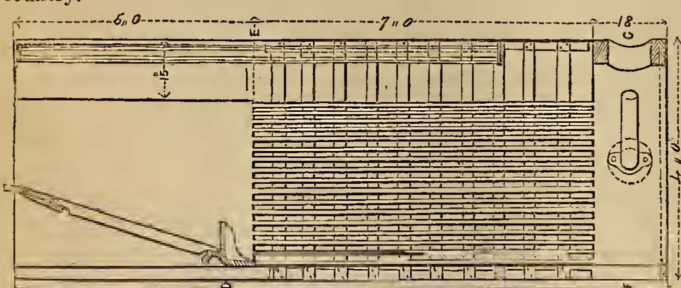


Fig. 1.—Longitudinal section, ¼ inch scale.

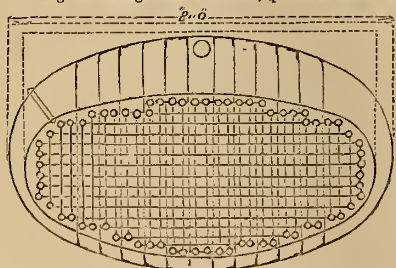


Fig. 2.—Transverse section.

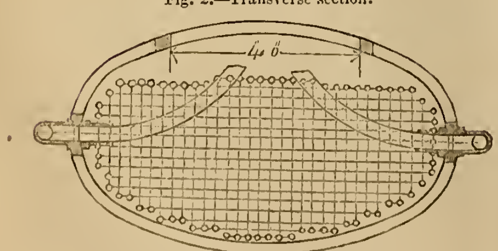


Fig. 3.—Transverse section.

We have much pleasure in being able to present drawings of the boilers, with accurate dimensions marked thereon. These boilers, and the engines, were made at the Alexanderoffsky head Imperial Mechanical Works, near St. Petersburgh, by the firm of Winans, Harrison, and Winans, who are Americans.

"The following are the dimensions of boiler, engines and boats, &c.:—

Length of boiler over all, not including furnace front...	13 ft.	6 in.
Length of furnace........	5	0
Ditto smoke-box	1	6
Length of tubes	7	0
Diameter of tubes inside, $1\frac{1}{2}$in.; full number put in ...	398	
Holes drilled for tubes........	400	

"Flat stays, extending from top to bottom of boiler, as shown in sketch, and rivetted to angle-irons at each end, and placed between every other row of tubes. The stays around the front and back part of boiler are placed about $4\frac{1}{2}$ inches apart, measuring over the outside casing: they are $\frac{7}{8}$ in. diameter, and screwed through both plates, and afterwards formed into snapped head rivets. Thickness of plates, $\frac{3}{8}$ in.; the height of boiler, 57 inches—from crown of furnace to top of boiler, 15 inches; water space at the back end, and bottom of front end, 3 inches; diameter of internal steam-pipe, $4\frac{1}{4}$ inches, and split open on the top side for admission of steam; exhaust-pipes, $4\frac{1}{2}$ inches, which extend along on each side of boiler, leading into smoke-box, and connected to the blast-pipe in chimney, which has a regulating valve similar to locomotive boilers; an iron plate or door fitted at the back end of boiler, and fastened on with stud-bolts, which are screwed into wrought-iron rings, shown. Those rings shown as cross-lined are let in between the plates, and rivetted secure.

"The crown of fireplace of boiler is drawn rather too close to the top, but the dimensions given are correct. There had been no back-bearer used for fire-bars at the trial-trips, but one had been proposed afterwards on account of the ashes having choked up the lower tubes. Take-up to chimney, 4 feet by 11 inches; pressure of steam in boiler on trial-trips, 70 to 80 lbs. on the square inch.

"*Screw.*—Diameter of propeller, 6 feet; pitch of screw, 12 feet; revolutions, 120 per minute; on Carlsund's principle, with rim, and consisted of eight blades; four of them extended from boss to rim, and the other four were suspended to rim, but not extended to boss. After two or three trials had been made, the four blades that had been suspended by the rim were removed: this did not make any difference to the speed of the boat.

"*Dimensions of Engines.*—Diameter of cylinders, 18 inches; stroke, 15 inches; cylinder ports, 10 inches × $1\frac{1}{2}$ inches; travel of main valve, $3\frac{1}{2}$ inches; expansion-valve working on back of main valve; travel of expansion-valve, 73·32 inches; stop-valve on front of boiler, on the sluice-valve principle, with two passages through it, each passage $5\frac{1}{4}$ inches × $1\frac{1}{4}$ inches, for supplying the two cylinders; diameter of feed-pumps, $2\frac{3}{4}$ inches—stroke, 15 inches, and one placed by the side of each cylinder.

"One cylinder placed on each side of the boat, and fixed at a very small angle, so that the back end of cylinder should be below the water-line; and a counter-balance fixed on propeller-shaft, to assist the engines over the centres. Diameter of propeller-shaft, 6 inches; length of connecting-rods, 2 feet $7\frac{1}{2}$ inches."

In addition to the above information, our Correspondent adds—

"The *dimensions of boat*, as informed, for I could not measure her myself, are—length, 95 feet; breadth over all, 20 feet 6 inches; depth, as near as I could judge, from top of hatchway to bottom of keel, about 10 feet: mounted three guns—the midship gun with a bore of 9 inches, and the other two with a bore of 8 inches, and from 9 to 10 feet long.

"The last order given was for thirty-two gun-boats: they were to be from 115 feet to 125 feet long, and about 22 feet 6 inches in beam; and the order given by Government was for 18-inch cylinders, with 16 inches stroke; and the prices given for *each pair of engines*—boiler and propeller (but nothing whatever to do with the building of the boats)—to one maker 18,500 silver roubles, and to the other 20,000 silver roubles; and one rouble may be calculated at 3s. 2d. English money. It was reported at that time, that as soon as the thirty-four were complete (including one that had been built at Abo), there were orders to be given for forty more. The time specified for their completion was the month of May."

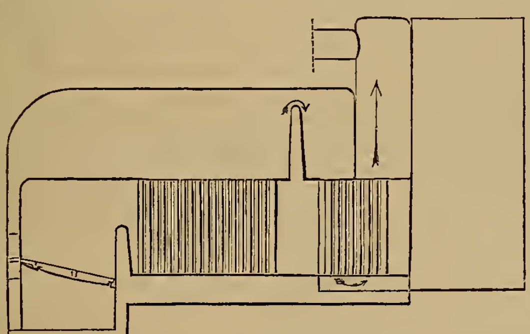
To the above interesting particulars he adds the following remarks :—

"I am aware that one firm had delivered theirs up complete in April. I am afraid that our Government will be greatly deceived with those persons : if they knew half as much about them as I do, they would not adopt any more half-measures, the same as they did at Odessa. You may judge how an Englishman must have felt on hearing songs sung in St. Petersburgh and Moscow, by the peasants, of one Russian gun-boat having captured two English men-of-war at Odessa. This song was got up to produce enthusiasm and to give them confidence, and they really did believe that such was the case. But had our fleet levelled the town, instead of playing with it as they did, there would have been some credit due to them, and the war most likely would have been brought to a close long before this time; as a disheartened Russian is worth nothing to fight; but if he believes he is really a match for his opponent, he will fight desperately. I can compare that power (Russia) to nothing else but a spider : they will do anything for any nation until they get them into the web ; when once in it, God help them! Some, if not all the gun-boats, have hose-pipes for throwing *boiling water* on the enemy.

"*August*, 1855."

AMERICAN NOTES.—No. IX.

Newly-invented Surcharged Steam-Boiler.—Mr. N. Thompson, jun., of this city, has invented a new method of surcharging steam in a boiler, which has been patented here, and the necessary measures taken to secure protection for it abroad. As this design is one possessing much merit, I have deemed it proper to furnish the accompanying drawing in illustration of it.



It will be observed that the steam generated in this boiler cannot flow to the steam-pipe without passing through the small vertical tubes in the back part of the boiler, and which are exposed to the effects of the furnace in the passage of the products thereof to the chimney.

In character of design and in outline this boiler is not unlike to the boilers in the steamers of the Collins line, the only differences, independent of the peculiar feature of surcharging the steam, being those of one range of furnaces in lieu of two, and in the absence of a steam-chimney, which is rendered unnecessary by the new arrangement.

The object of the invention is that of readily super-heating the steam generated in a boiler, without resorting to the use of pipes exposed to the direct contact of the fire of the furnaces, and also to remove the necessity of a steam-chimney running up above the shell of the boiler, and compelling steamers of war either to dispense with this essential part in the economy and efficiency of a boiler, or to incur the risk of its exposure to gun-shots, from the impracticability of having it below the water-line, except in very large vessels, and with them only where steam is used as auxiliary to canvas ; and, therefore, the dimensions of the boiler are so restricted as to enable it and its chimney to be accommodated within the limits of the water-line. The necessity of any steam-chimney at all, I am well aware, will not be admitted by most of your domestic readers ; but we, upon this side, think and practise very differently. We have tried boilers with steam-chimneys and without them ; and, independent of any gain in efficiency and economy of operation of the boiler having them, we would not dispense with them, in consideration of the increased security of them from fire, over that of any attachment of a smoke-pipe upon a horizontal line, or so low down in the hold or boiler-room of a vessel as it must be when connecting directly with the boiler.

Steamer "Metropolis."—Since my last communication regarding this vessel, I have obtained some further elements and facts regarding her, which it is proper should be recorded with what has preceded.

Her cylinder is more than one-third larger than that of any other single marine engine in the world, being 1¾ inches greater diameter and 3 feet more stroke than the cylinders of the Cunard steamer *Arabia*, which are 103½ inches diameter by 9 feet stroke. The extraordinary capacity of the cylinder of the *Metropolis* will be better appreciated when it is known that twenty-two invited guests found comfortable seats at a table, and collation served by Messrs. Stillman, Allen, and Co., within its walls. After the table was removed, a horse and carriage were driven through by Col. Borden and others, the top standing. Further, 103 men found standing-room therein at one time.

Dredging Machines.—Mr. D. S. Howard, of Lewis Co., N.Y., having effected improvements in the construction of a dredging-machine, the United States Topographical Corps had four constructed and put in operation—one of them at Whitehall, N.Y., upon Lake Champlain—the others at Lakes Ontario, Erie, and Michigan ; and from the operations of the former, the following elements and results were noted by the officer in charge, and are presented to the public in an article in the "Journal of the Franklin Institute" for July, by John W. Nystrom, of Philadelphia.

DIMENSIONS OF THE DREDGE-BOAT.

Length from centre of rudder to outer side of stem......	109 ft. 6 inches.
Breadth of beam	26 1
Ditto over all........................	41 1
Mean draft........................	2 10
Greatest immersed section	68 square ft.
Tonnage of displacement	141 tons.

Two horizontal high-pressure engines:—

Diameter of cylinders	12⅛ inches.
Stroke of piston	4 feet.

Two cylindrical boilers, placed side by side, half surrounded by brick-work, forming the first flues:—

Length of boilers	20 ft. 3 inches.
Outside diameter	3 4½
Two flues in each boiler, inside diameter........................	0 14⅝
Total heating surface in both boilers	617 square feet.
Ditto, fire-grate........................	37 "
Area of draft to fire-grate	6 "

The boat was provided with paddle-wheels to move her from place to place, the paddle-wheel shaft being connected to the main shaft by couplings, so that the wheels could be worked together or separately:—

Extreme diameter of paddle-wheels	15 feet.
Number of blades in each	14.
Each blade 5 ft. wide by 15 in. deep	= 6·25 square ft.

DREDGING MACHINERY.

There are two sets of buckets, one on each side of the boat. The buckets are connected by two chains of alternate wrought and cast iron links: the wrought-iron links are 8 inches between the centres by half an inch thick, forming the space for the studs on the chain-wheels; while the cast-iron links are 6 inches between the centres by 2½ inches thick, fitting between the studs. The wrought-iron links are rivetted one on each side by steel pins to the ends of the cast-iron links, making the pitch of the chain 8 + 6 = 14 inches, and five pitches = 5 feet 10 inches between each bucket.

The buckets are made of ¼-inch boiler-iron, 2 feet 6 inches by 1 foot 3 inches at the top, and 2 feet deep, making the capacity of each bucket 6¼ cubic feet.

A partial synopsis of the Table of Performances presents the following results:—

Time of Operation in Minutes.		Depth in Feet of Excavation.					Number of Feet the Machine was moved per Minute.	Engine.			Excavated Materials in Tons per Hour.	Material.
Excavating.	Employing Scows.	Bottom.		Water.		Total.		Revolutions.	Pressure.	Horse Power.		
		ft.	in.	ft.	in.	ft.						
13	4	3	3	7	9	11	4·61	40	25	20	146	Soft clay.
13	3	3	9	7	3	11	4·00	39	20	15·6	166	Mud, very soft.
9	2	3	0	8	0	11	6·20	47	25	23·5	238	Common clay.

Speed of machine when in transit from one location to another—78 miles in 12 hours and 2 minutes, or 6½ miles per hour.

Formulæ and Rules for Dredging Machinery.

The following formulæ and rules were deduced by Mr. Nystrom from the performances of a number of dredging-machines built in Motala, Sweden, some of which have since been published in his "Pocket Book of Mechanics and Engineering."

Letters denote—

T = tons of materials excavated per hour.

h = height in feet to which the excavated material is raised above the bottom of the excavated channel.

H = horse-power required to excavate T, tons of material per hour.

k = coefficient for the different kinds of materials which have been found by actual performance.

Very hard clay mixed with gravel .... $k = 0{\cdot}1$
Hard, pure clay .... $k = 0{\cdot}07$
Common clay or sand .... $k = 0{\cdot}05$
Soft clay or loose sand .... $k = 0{\cdot}04$
Very soft and loose sand .... $k = 0{\cdot}03$

$$H = T\left(\frac{h}{700} + k\right)$$

This is the formula for finding the horse-power required to excavate T, tons of material per hour, and raise it to feet.

Example 1.—A harbour of hard, pure clay is to be excavated to 15 feet of water, the material to be raised 11 feet above the water-line, making the height $h = 15 + 11 = 26$ feet. It is desired to raise $T = 250$ tons of clay per hour. Required the horse-power necessary for the excavation?

$$H = 250\left(\frac{26}{700} + 0{\cdot}07\right) = 26{\cdot}785 \text{ horses.}$$

Given the horse-power, to find the quantity of materials that can be exavated per hour.

$$T = \frac{700\,H}{h + 700\,k}.$$

To find the power necessary to loosen the material without raising it. This will be found by the insertion of the height $h = o$ in the formula 1, and will appear simply $H = T\,k$.

To find the resistauce opposed to feeding the dredge by excavation. Let

v = velocity of the buckets in feet per second, and

F = the force in pounds resisting the feed motion of the dredge, we shall have the force.

$$F = \frac{550\,H}{v} = \frac{550\,T\,k}{v}.$$

Example 2.—A dredging-machine is to excavate $T = 160$ tons of very hard clay per hour, and the velocity of the buckets $v = 0{\cdot}89$ feet per second. Required the force necessary to feed the dredge ahead, F?

$$F = \frac{550 \times 150 \times 0{\cdot}1}{0{\cdot}89} = 8269 \text{ pounds.}$$

If only one kedge anchor and cable is used for feeding the dredge ahead, the circumference of the cable should be—

$$\text{Circumference} = \sqrt{\frac{9269}{120}} = 8{\cdot}78 \text{ inches, or } 2\tfrac{3}{4} \text{ inches in diameter.}$$

New York. H.

NOTES BY A PRACTICAL CHEMIST.

Colouring of Stone.—Building-stone may be tinted in different shades by impregnating it with metallic salts, and then adding a precipitating reagent. By means of salts of lead and copper, with sulphuretted hydrogen, greys, browns, and blacks may be produced. Copper and ferrocyanide of potassium give a red tint. If porous limestones are boiled in solutions of metallic sulphates, carbonic acid is evolved, and the metallic oxide, combined with sulphate of lime, is deeply fixed in the stone. In this manner, sulphate of iron gives rusty tints, sulphate of copper a fine green, sulphate of manganese a brown, and mixed sulphates of iron and copper a chocolate. The double sulphates thus formed increase the hardness of the stone.

Artificial Stone.—Chalk, either in the lump, or reduced to a paste, and steeped in a solution of silicate of potash, absorbs a considerable quantity of silica. It acquires a smooth appearance, close grain, and yellow colour. The stone thus prepared takes a very fine polish, and hardens by degrees from the surface to the interior. This process may be advantageously employed for making mouldings, delicate sculptured ornaments, &c.

Ancient monuments of calcareous stone may be preserved by washing with silicate of potash. White limestones are silicated with double silicate of potash and manganese. When the stones are too dark, excellent results are obtained by suspending in the silicate a little sulphate of baryta, which penetrates into the porous stone along with the silica, and remains there in a state of combination. The joinings may be concealed by fragments of the stoue ground up to powder, mixed with the silicate of potash, and applied as a paste.

Hydraulic Limes.—All hydraulic limes and natural cements contain potash and soda. These alkalies serve to transfer silica to the lime so as to form silicates, which, when in contact with water, solidify a portion of water by hydratisation, like that of plaster. By mixing common lime with an alkaliue silicate, both finely powdered, in the proportion of 10 or 12 of the latter to 100 of the former, a hydraulic lime may be prepared. This process will prove advautageous.

Determination of Arsenic.—If arsenious acid be brought in contact with chromic acid in presence of free sulphuric acid, the former is peroxidised into arsenic acid at the expense of the chromic acid. 297 parts of arsenious acid, containing 225 of arsenic, require for their oxidation to arsenic acid 203·228 of chromic acid, which are contained in 297·516 of bichromate of potash. But 297·516 bichromate with oxalate of soda and sulphuric acid would evolve 264 carbonic acid; so that 297 of arsenious acid, containiug 225 of arsenic, will give rise to a loss of 264 of carbonic acid. Hence it follows that the arseuic may be determined from the quantity of chromic acid reduced. The process cousists simply in mixing the substauce with a weighed excess of bichromate in the presence of free sulphuric acid and oxalate of soda, and determining the excess of chromic acid from the carbonic acid evolved. The carbonic acid is then absorbed by a weighed solution of potash in a Liebig's bulb apparatus. If the arseuic be present as arsenic acid, it must be previously reduced by treatment with sulphurous acid; and if both arsenious and arsenic acids are present, the former must be determiued separately in one portion, and afterwards the whole amount of arseuic in another in which the arsenic acid has been reduced. The amount of the latter is then calculated from the difference. If chlorine be present, oxide of mercury must be added.

Determination of Iron.—To determiue the iron in proto-salts, we add a weighed excess of bichromate, acidulate with sulphuric acid, and heat to boiling. The mixture is then neutralised with ammonia, oxalate of soda and sulphuric acid being added, so as to determine the excess of chromic acid by the carbonic acid. If chlorine be present, oxide of mercury is added. As one atom of red chromate evolves six atoms of carbonic acid (when treated with oxalate of soda and sulphuric acid), the amount of carbonic acid which the whole should have evolved, had no reduction taken place, may easily be calculated. By subtracting from this the quantity actually obtained, the amount of chromic acid employed in oxidising the iron is found, and from this the latter is calculated. 168·2 of iron require in peroxidisation 148·7 bichromate, which represents 132 carbonic acid. If the iron is present as peroxide, it is reduced by means of zinc or sulphurous acid; and when both oxides are mixed, the protoxide is first ascertained, then the whole amount of iron after reduction by a second operation, when the difference answers to the amount of peroxide.

ANSWERS TO CORRESPONDENTS.

"A Soap-boiler."—We are not at liberty to state the composition of a substance placed in our hands professionally, and which may possibly become the subject of a patent. The detergent of Mr. Fox has been tested by laundresses and others with the happiest results. It cleanses linen perfectly without the use of hot water, and without any of those corrosive properties so detrimental to the tissue.

"P."—A specimen forwarded to the office of this Journal will meet with immediate attention.

SMOKE CONSUMPTION.

There are but few of those who are engaged in extensive manufacturing operations, or who have, under any circumstances, occasion to employ steam-boiler or other furnaces upon a considerable scale, that have not had their minds more or less occupied, during the last nine or ten months, with the subject of smoke consumption. The fact is, that, under the operation of the present Act of Parliament, the question is one of very great importance to all who employ furnaces, either for steam-boilers or other purposes; but it is, above all, important to those who carry on processes of manufacture which necessitate furnace operations. The peculiar construction of boiler-furnaces, and the method in which they are worked, render it comparatively easy to devise, as far as they are concerned, an arrangement of the interior of the furnace, by means of which the smoke may be sufficiently consumed to insure, to a certain extent, the fulfilment of the letter of the law. But this is not the case with the furnaces which are employed in many manufacturing processes, for two reasons: first, in consequence of their particular character, arising from shape, arrangement, or want of size; secondly, from the fact that such furnaces are often worked very irregularly—the fires being suddenly drawn from some, and kindled at different periods in others; so that, in a factory of any extent, certain of the furnaces will almost always be in that state in which the consumption of their smoke is an impossibility. This is a difficulty which the law has cast upon the shoulders of manufacturers, and for which it is not easy to find a remedy: indeed, the whole question of smoke consumption appears, as yet, to be entirely open—that is, in a practical sense; for, of all the schemes more or less in operation at the present time, there is, probably, not one which wholly fulfils the objects with which it was adopted.

Considered from a scientific point of view, the subject of smoke consumption is not limited by the mere question of public health or convenience: so far as the manufacturer is concerned, it extends to a much wider, and, to him, more important range—and, indeed, may be justly said to relate to the whole theory and practice of furnace economy.

If any one interested in the question of consuming the volatilised products of the imperfect combustion which occurs in ordinary furnaces were to take the trouble to examine critically the many different projects that have been devised for effecting such a consumption of the combustible matter which now, in most cases, flies away useless up the chimney, he could scarcely fail to be struck with the fact that an extraordinary discrepancy exists between the theoretical views by which the respective inventors of these contrivances were guided. This proves that practical men are furnished with but meagre data concerning the true nature of the process which goes on within a furnace: otherwise, it is very difficult to comprehend how such opposite means could have been resorted to, to effect one and the same object.

The fact is, that to discover the best means of smoke consumption is a problem belonging rather to the chemist than the engineer; and unless an adequate amount of chemical knowledge is brought to bear upon it, the constructive ability of the latter is likely to be frequently exerted without producing any very beneficial results.

The first point of inquiry in this case relates to the character of the chemical changes which take place during the combustion of ordinary fuel; the second, to the mechanical adaptations which are required to permit of certain mutual laws coming freely or uninterruptedly into operation. With regard to the nature of the chemical action involved in the process of combustion, the matter is simple enough—repeated investigations have clearly explained these phenomena; but with respect to the mechanical contrivances by means of which that chemical action is to be maintained continuously at its maximum, without, at the same time, establishing a deteriorative action, much greater difficulty exists. We now know perfectly well that the phenomena of combustion are all the result of a very common—nay, universal chemical action, termed oxidation; that the consumption of the coals in a furnace consists in nothing more than the combination of the chemical principles or elements of the coal with the oxygen of the atmosphere which feeds the furnace. This action is identical with the rusting of a piece of iron; but, taking place under the influence of a raised temperature, it proceeds with great vigour and rapidity, and consequently gives rise to appearances which are absent during the rusting or oxidation of the metal. The essential constituent elements of coal are carbon and hydrogen: if, as we have said, combustion consists in oxidation of the elements of the burning body, it is obvious that the burning of coal must result in the formation of oxides of carbon and oxide of hydrogen. The oxides of carbon are two; the first being the *combustible* gas, termed by chemists carbonic oxide $= C\ O$; the second, the *incombustible* gas, called carbonic acid $= C\ O_2$. The oxide of hydrogen is water $= H\ O$. If the combustion of carbon take place with free access of air, it is all converted into its highest oxide, carbonic acid; but if the supply of air be limited, then carbonic oxide is produced. When coal is distilled in a close vessel, such as a gas retort, it may be said to be burned without access of air; its elements then assume new combinations among themselves, and take principally the form of a transparent, combustible gas. If a quantity of fresh coals be thrown upon a hot furnace fire, it is partly burned and partly distilled; the products of the distillation are then also partially burned; but the end is, that a great portion of matter susceptible of combustion flies away up the chimney in the shape of carbonic oxide, free carbon, compounds of carbon with hydrogen, and free hydrogen gas. A moment's consideration of the physical state of the matter which passes from the flues of a furnace, and of the chemical conditions which prevail at the time, must render it obvious that the above statement is correct. If such be the case, it must be equally obvious that a great portion of the calorific effect of the fuel is lost. Now, with regard to the possibility of so completely burning the fuel as to obtain from it its maximum heating power, chemists inform us that exactly so much oxygen must be admitted into the furnace as will suffice to convert all the carbon of the coal into carbonic acid, and all the hydrogen into water. The first of these is a transparent, invisible gas; the second, if it preserve the vaporific state so far as the mouth of the chimney or shaft, would of course escape under the form of steam: in either case the presence of smoke—that is, unconsumed carbon—would be an impossibility. In order to completely burn up the combustible gases, which, as we have already stated, constitute the body of smoke as it escapes from ordinary furnaces, it is only requisite that, at a given temperature, they should be supplied with their equivalent proportion of oxygen. This, we again learn from chemistry, is not a varying, but a uniform quantity: for every atom of hydrogen, either free or combined, one atom of oxygen is necessary to effect its combustion, and convert it into water; so, for every atom of carbon, two atoms of oxygen are required to bring it to the state of carbonic acid—that is, to completely burn it. Now, the problem which offers itself for solution in respect to the subject of smoke consumption is, what are the best means of supplying oxygen at the requisite temperature to the unburned products of the furnace, so as to insure their subsequent entire oxidation and consequent combustion? Under the circumstances in which air is admitted into common furnaces, the total oxidation of the elements of the burning body is almost impossible: the air which traverses the furnace-grate can scarcely be so mingled with the particles of volatilised matter, as they rise from the mass of fuel, as to insure their perfect combustion; for it must be remembered that the combustible gases evolved from the fuel are under the influence of the draught of the chimney, and that a great proportion of the air which is admitted, instead of mixing with these gases, rushes in their train, merely following them in their rapid course through the flues, and only combining with such as are brought under its influence. It is not enough that a large volume of air be admitted into a furnace; the great point is to admit the proper quantity of air, and to apply it to the burning materials in such a manner as most completely to effect the oxidation of the elements of those materials. Every atom of air admitted into the furnace after the due and proper quantity is reached, exerts a mischievous effect by lowering the temperature and wasting the fuel. It is necessary that the supply of air should be furnished at the proper part of the furnace, at the proper time, and in the proper quantity, to effect complete oxidation. This is the theory of the furnace: how these objects are to be attained in practice, it is not so easy to say.

It must never be lost sight of, that the air and the gases produced in the combustion are travelling through the furnace with immense velocity—a velocity which probably equals, in a furnace with a good draught, 100 or 150 feet per second, or even more than this. If air be injected or allowed to pass into a furnace in which such a powerful current is rushing along, it is manifest that the extent to which the particles of air will mingle with the particles of combustible gas will very much depend upon the point at which the air is admitted, and upon the manner in which it is admitted. If, for instance, it were allowed to enter only by the anterior part of the furnace, it would be evident, *à priori*, that it would, as it were, merely follow the volume of gas—that it would be very difficult for any mingling of the aëriform particles to take place to a great extent, as the volumes of air and combustible vapour and gas would have only a sort of general surface contact, as if two clouds were following each other in the same course, with their surfaces in contiguity, but without any mingling of their particles. When combustible gases are raised to a certain high temperature, which varies according to the nature of the gas, in the presence of oxygen they immediately ignite and undergo combustion. If, however, this high temperature be applied to the gas, out of the reach of oxygen—in a close vessel, for example—the gas will remain chemically unaltered. In a furnace the conditions of the burning matter are these: a portion of the fuel is burned by the air which finds admission through the furnace-bars; another portion gives off, under the action of the heat, volatile combustible compounds, which, rising into the body of the furnace and then passing rapidly into the flues, are exactly in the circumstances of the combustible gas heated out of contact with oxygen: they are, as they pass out of the furnace, endued with that peculiar chemical constitution, and are raised to a sufficiently high temperature to enable them to burn; but the means of combustion—the oxygen—is wanting. If this element of combustion could be supplied, all the conditions required to effect the complete oxidation of the combustible matters would be present; and, in such a case, not only is the fuel made to enact its maximum calorific power, but the consumption of the smoke is entirely and successfully achieved. Looking back upon the earliest efforts of experimenters upon this subject, it is important to remark, that many of their contrivances seem to have been the result of the closest observation and appreciation of the true conditions of the problem which they undertook to solve; whereas, many later inventions are, on the other hand, characterised by the most singular disregard of the natural principles which ought to have governed them. The question itself is one of such wide importance, both in a sanitary and industrial point of view, that it merits the closest inquiry; for, as we before remarked, it comprehends within itself all the points connected with the most economical production of heat in the arts and manufactures.

REVIEWS AND NOTICES OF BOOKS.

The Marine Steam Engine. By Thomas J. Main, M.A., F.R.Ast.S., &c. &c., and Thomas Brown, Chief Engineer R.N., &c. London: Hebert.

Many have been the books written on the steam-engine, and most of them have viewed the subject in a strictly professional or in a simply descriptive light. But there is another point of view, and it costs a more laborious effort than either of the others, and which is, to assume the reader is uninitiated, yet willing to receive an explanation of every fact adduced, every professional term employed. Nor must a line be drawn between this which is mechanical, and that which may be philosophical; but let philosophical reasoning fully explain the one, and mathematics render their assistance to sufficiently develop the other, thus bringing every essential to the level of an ordinary capacity. Such an important task the authors of this work have successfully done—and done it, too, so successfully as to call for this the third edition of their most excellent work.

To the uninitiated it offers the desirable information in a clear, descriptive style; not that of a mere book-maker—as that of a practical engineer; and the calculations which are occasionally introduced, are those of a sound mathematician.

We have gone through the present edition somewhat hurriedly, glancing only over its pages; but, in doing so, we notice what appears to us to be an imperfect description of what our authors call "the equilibrium valve." Now, this valve, represented at page 92, is neither more nor less than a double-beat valve, *and may or may not be an equilibrium valve* in the strict sense of that term; for, as is well known, the Cornish pumping-engine, as a rule, uses steam from the boiler only on the down-stroke, and the piston remains down—although the steam-valve be already shut, yet the upper part of the cylinder remains full of steam—until the equilibrium valve is opened, which act of opening allows the steam a passage from above to below the piston, and *an equilibrium of pressure* on both sides of the piston is the consequence. So, also, the ultimate result is, that the weight of the pump-rods is sufficient to raise the piston to its original position at the top of the cylinder; for the opening of this valve had removed any and every preponderating pressure on the upper side of the piston by producing an *equilibrium of pressure on both sides* of it, and allowing the pump-rods to obey the natural laws of gravity. When the piston has arrived at the top of the cylinder, and the steam has changed sides—of the piston—by the passage afforded at the opened equilibrium valve, then, and not until then, the eduction valve is opened, and the steam which has thus been twice in the cylinder is permitted to escape into the condenser.

We notice in chapter ix. some excellent rules for dealing with the screw-propeller. The maxims for managing marine machinery are most useful, and one of the leading features of this work.

The Appendix contains some useful hints upon coaling; and pp. 339 to 353 are devoted to original articles, and of the highest practical importance, on "The Qualities of Fuel," "The Weight for Bulk of Coal when stowed for use," "Patent Fuels," "The Effects of Stowage upon Coals," "The Decay of Coals," and concludes with some elaborate tables with reference to the power and duty, and the comparative values, of various coals, &c. &c.; all of which are excellent.

To the practical marine engineer in charge of steam machinery, as well as to the student of marine steam knowledge, this work will be found of the greatest assistance, as it contains accurate information upon every circumstance or casualty likely to occur in the working of marine engines afloat.

The Iron Manufacture of Great Britain Theoretically and Practically Considered. By William Truran, C.E.—E. and F. N. Spon, 16, Bucklersbury. August, 1855.

We have hastily glanced at this work, and without pretending to have done more than cursorily examine the treatment the subject has received at the hands of Mr. Truran, and promising that shortly we will refer again to the work, we are free to say that the subject has been treated very fully and practically by the Author, who has had many years' practical experience in connexion with iron manufacture, at the works of Sir John Guest, and also those of Mr. Crawshay.

The want of such a work has been much felt, as hitherto the most recent work upon the subject of the manufacture of iron, although in the English language, was by an American author. The able and practical treatment of the subject by Mr. Truran must insure the position of the work as a standard book of reference.

Practical Geometry, &c. By R. Burchett, Head Master of the Training and Normal School, Board of Trade, Department of Science and Art.—Chapman and Hall, Piccadilly. 1855.

This admirable work recommends itself to the attention of those desiring a full yet ready acquaintance with practical geometry.

The Author has treated the subject which he professes to teach in a clear and telling manner, and gives a large collection of diagrams in illustration of the mode of working the problems, &c., which have been chosen for the course which is passed through by the masters in training for schools in connexion with the Department of Science and Art, at the Training School, Marlborough House; the method of teaching there adopted being that of lecture, with the drawings made on the black board by the teacher, the students making notes at the time, and afterwards making careful drawings, with the necessary written descriptions.

The superiority of this method of teaching over that of placing sheets of geometric figures, with printed descriptions, before a student, and allowing him to copy both, need not be enlarged upon. To extend this method of oral teaching is the principal object sought to be promoted by the publication of the course of study of which the Author treats.

An Essay on the Theory of Colour, and its Application to Architectural and Mechanical Drawing. By William Minific, Baltimore, U.S.—Also, *Popular Lectures on Drawing and Design.* By the same Author. —Trübner and Co., Paternoster-row.

THESE works, by the Author of a "Text-Book of Mechanical Drawing," &c., are, in point of style and excellence, similar to the latter work, which is now well known, from having been adopted in the Department of Art in the Government School of Design in this country, and which was noticed by us in February, 1852.

The practical treatment of the subjects by the Author leaves nothing to be desired: his "Essay on the Theory of Colour" forms an appendix to the "Text-Book of Mechanical Drawing," rendering that work complete.

The "Popular Lectures on Drawing and Design" merit a less modest title; for although they are styled popular, they deal with the subject in a manner so thoroughly practical, clear and directive, that a better or more concise handbook to the practice of drawing and designing cannot be found.

LIST OF NEW BOOKS, OR NEW EDITIONS OF BOOKS.

BURCHETT (R.)—Practical Geometry: the Course of Construction of Plane Geometrical Figures used as a part of the Course of Instruction in the Training School, Marlborough House, and in the Schools of Art in connection with the Department of Science and Art. By R. Burchett. Crown 8vo, pp. 110, cloth, 5s. (Chapman and Hall.)

DALLAS (E. W.)—The Elements of Plane Practical Geometry, with Illustrative Applications. By E. W. Dallas. 8vo, pp. 168, cloth, 7s. 6d. (Parker and Son.)

FLINT (J.)—Geography of Productions and Manufactures, with Appendices. By John Flint. 18mo, pp. 58, sewed, 4d. (Hope.)

GALBRAITH (J.) and HAUGHTON (S.)—A Key to the New Edition of a Manual of Mechanics, by the Rev. Joseph Galbraith and the Rev. Samuel Haughton. By James M'Dowell. 12mo (Dublin), pp. 72, sewed, 2s. (Allan.)

MARSHALL (F. A. S.)—Photography; the Importance of its Application in preserving Pictorial Records of the National Amusements of History and Art; with Appendix, containing a Description of the Talbotype Process. By the Rev. F. A. S. Marshall. 8vo, pp. 30, sewed, 1s. 6d. (Hering and Remington.)

RUSKIN (J.)—The Seven Lamps of Architecture. By John Ruskin. With Illustrations drawn by the Author. 2nd edition, royal 8vo, pp. 213, cloth, 21s. (Smith and Elder.)

ARNOTT (N.)—The Smokeless Fireplace, Chimney-Valve, and other Means, new and old, of obtaining healthful Warmth by Ventilation. By Neil Arnott, M.D. 8vo, pp. 232, cloth, 6s. (Longman.)

DEMPSEY (G. D.)—The Practical Railway Engineer; a Concise Description of the Engineering and Mechanical Operations and Structures which are combined in the Formation of Railways for Public Traffic, &c. By G. Drysdale Dempsey. 4th edition, 4to, cloth, £2 12s. 6d. (Weale.)

HERRING (A.)—Paper and Paper Making, Ancient and Modern. By Richard Herring; with an Introduction by the Rev. G. Croly. 8vo, pp. 116, cloth, 7s. 6d. (Longman.)

JOYCE'S Scientific Dialogues. New and enlarged edition, completed to the present state of knowledge. By Dr. Griffith. Post 8vo, pp. 600, woodcuts, cloth, 5s. (Bohn's Scientific Library.)

LAXTON (H.)—Examples of Building Construction; intended as an *Aide Mémoire* for the Professional Man and the Operative: being a Series of Working Drawings on a large scale, exemplifying the Arrangement and Details adopted in carrying out the several branches of Trade requisite for Public or Private Edifices. By Henry Laxton. Part I., folio, sewed, 2s. 6d. (Laxton.)

MATHEMATICS.—A Key to Practical Mathematics. 12mo, pp. 320, cloth, 4s. 6d. (Chambers's Educational Course.)

MURRAY (J.)—A Treatise on the Stability of Retaining Walls, elucidated by engravings and diagrams. By John Murray. Part I., royal 8vo, pp. 74, sewed, 5s. (Weale.)

RHAM (W. L.)—The Dictionary of the Farm. By the late W. L. Rham. Revised and re-edited, with Supplementary Matter, by W. and H. Rainbird. Crown 8vo, half-bound, advanced to 5s. (Routledge.)

TODHUNTER (J.)—A Treatise on Plane Co-ordinate Geometry; with numerous Examples. By J. Todhunter. Crown 8vo (Cambridge), pp. 300, cloth, 10s. 6d. (Bell.)

TRURAN (W.)—The Iron Manufacture of Great Britain Theoretically and Practically Considered. By William Truran. Illustrated by 23 plates of furnaces and machinery in operation. 4to, pp. 178, cloth, 42s. (Spon.)

ON THE MANUFACTURE OF STEEL, AS CARRIED ON IN THIS AND OTHER COUNTRIES.*

By CHARLES SANDERSON.

THE manufacture of steel is of great antiquity, coeval, if not anterior, to that of iron; it was known to the Chaldeans, the Hebrews, and the Greeks: the processes they are said to have used are detailed by Aristotle, Pliny, and Plutarch, but they are so obscure and contradictory that no reliance can be placed upon them. It appears most probable that steel was, in the first instance, produced accidentally, whilst attempting to obtain iron. This question is, however, more curious than useful; I therefore dismiss it, and turn to the subject before me. Steel is a carburet of iron, more or less freed from foreign matter; it can be produced by two processes, opposed to each other. The first, or earlier method, is by working pig-iron, which, on an average, contains 4 per cent. of carbon, in a suitable furnace, until the carbon it contains is reduced to that quantity required for steel, which is 1 per cent. The second method is to heat wrought-iron in bars (which contain little or no carbon), in contact with some carbonaceous matter, until it has absorbed that quantity of carbon which may be required for hard or soft steel purposes.

The various kinds of steel which are now manufactured in this and other countries, are—

Natural or raw steel, which is manufactured from crude iron as obtained from the blast-furnace;

Cemented or converted steel, which is produced by the carbonisation of wrought-iron;

Cast-steel, which is obtained by the fusion of either natural or cemented steel, but principally from the latter.

In the manufacture of steel, the quality of the iron from which it is made is of the first importance; it is absolutely necessary that it should be free from earthy matter, silicates of the metal, sulphur, arsenic, &c. Any foreign matter contained in the iron is very injurious for steel purposes, but the silicates are, in my opinion, the most deleterious, since they produce a red short quality, caused by their mechanical mixture with the carbonised molecules of the steel, thus destroying the malleability of the mass. The mines of Danemora have for many centuries enjoyed the highest reputation for producing iron of the finest description for steel, and this alone should be used for producing the very best cast-steel. The high reputation and scarcity of this iron have combined in commanding for it a very high price. The marks Ⓛ. GL. OO. are made wholly from the Danemora ores; the marks GF. W. B. Grid, and some others, receive only a portion of these ores mixed with others in their manufacture. Sweden produces also a large quantity of iron suitable for steel, but of inferior quality to the above, and technically termed 2nd and 3rd marks. The ores from which the Swedish irons are produced are almost wholly black oxides, usually containing 50 to 60 per cent. of metal; they are very clean and pure, and might, if properly manufactured, produce finer iron than that generally obtained. Their works are, in too many instances, badly constructed; and the manufacture itself is so far from being perfect, that there is a great unnecessary waste in the manufacture of the pig-iron into bars, and also in the quantity of charcoal necessary to produce a ton of iron: nevertheless, these commoner irons are sold for steel purposes. Recently some of the Swedish works have introduced our English charcoal refineries, and our mode of working, by which a sounder iron is obtained, and one freer from adventitious matter. The price of Ⓛ is £36; GL £33; OO £32; GF and W £32; B £30; Grid and Stembuck, £24, at the present high prices. The iron called 2nd mark varies in price, according to its intrinsic quality, from £25 to £18; the 3rd mark, from the latter price to as low as £13 per ton. Russia sends also a large supply of iron for steel purposes, of which the marks Kb and IOP3 form the mass, being from 6,000 to 7,000 tons annually. This iron is of good medium quality, and sells readily at from £17 to £19 per ton in ordinary times. It is manufactured in the Ural district of Russia, by the usual charcoal refinery process. A part appears, however, to have been puddled, using wood for fuel. In 1830 it was a question whether a puddling furnace could be so constructed as to admit of the use of wood: Berzelius was of opinion that it could not. During my residence in Styria and Carinthia, in 1832, I erected a puddling furnace at the works of Mr. Rosthorn, in Wolfsberg, in which wood was used as a fuel. I experienced no difficulty in working it, and it produced very good iron, with a large economy of fuel when compared with the charcoal-refinery process. In this furnace I puddled 30 cwt. of charcoal iron in 24 hours. During this time I consumed 180 cubic feet of wood, as usually measured in the forest, equal to about 1½ cord our measure. The blooms hammered very solid, and the waste was 10 per cent. The furnace was a small one, and the fire-room much larger than that used for coal. Since this trial, several works have used the process, both in Sweden and Austria, but it has not become general. By this plan an excellent steel-iron can be produced. Steel-iron may also be produced direct from the rich ores of this and other countries. For this process Mr. Clay obtained the first patent. It was tried in Liverpool, but was unsuccessful; first, because he could not sufficiently deoxidise the ore; and subsequently, in its manufacture into malleable iron, he could not get rid of the earthy matter: this rendered his iron unfit for steel, as well as ordinary purposes. I obtained the next patent, in which I provided for a more ample deoxidation of the ore, and also for the separation of the earthy matter from the metallic: this iron made good steel. There exists a variety of causes why this process has not been worked, although perfect in itself: it is, however, now about to be adopted for the production of steel-iron from the rich ores of England, which, if properly manufactured, will produce an excellent steel. Since this important branch of manufacture is becoming daily of greater importance, every step towards the production of fine steel-iron in this country should be encouraged, inasmuch as it makes our own resources available for our wants.

In the manufacture of common steel, particularly that for railway springs, a very large quantity of steel-iron is produced from English materials. Of this kind of iron not less than 15,000 tons are annually consumed in Sheffield, for springs and common hardware. This iron is produced from the coke-made pig-iron, by puddling; during which process substances are added which, although not always the same, yet produce nearly similar effects.

Oxide of manganese, salt, sulphuric acid, and clay, mixed together, formed the patented substance of Dr. Schafhaeutl; by the addition of which into the puddling furnace, the metal becomes freed in a great measure from the earthy matter contained in the crude iron, and a purer and denser iron is produced.

---

* Paper read before the Royal Society of Arts.

It is well known that the process of puddling and rolling was the invention of Mr. Cort, of Gosport: it was introduced in 1784, before which period the charcoal finery alone was used. This invention opened a new and extensive field for the industry of the nation; coal became the medium of the manufacture of wrought-iron instead of charcoal, and the process has expanded the production of this kingdom from 17,000 tons in 1740, to 3,000,000 tons in 1854. The facility with which malleable iron can be produced with coal has caused the erection of magnificent and colossal iron-works, finding profitable occupation for a great number of men, and producing throughout the ramifications of its manufacture, and its subsequent uses, an amount of wealth almost incalculable. This is somewhat foreign to the subject, excepting that, by the use of this invention, the steel-iron market is annually supplied with 15,000 tons; and to me it is a pleasure, as it is a pride, to bring forward to public notice the invention of a man which has produced such astonishing results in our works, our railways, and steam navigation.

At present we are largely indebted to Sweden for our supply of suitable iron for the manufacture of steel.

The following is a statement of our importation since 1845:—

	Tons.		Tons.
1845	18,607	1850	28,096
1846	30,840	1851	35,467
1847	28,264	1852	23,817
1848	20,438	1853	23,540
1849	26,605	1854	24,436

With very trifling exceptions, the whole of this iron is used for steel. The above figures give an average importation for ten years of 26,011 tons, to which we must add the importation from Russia and the steel now made in England. I therefore estimate the weight of steel manufactured in England at 40,000 to 50,000 tons annually.

The fuel used in England for the manufacture of steel is entirely coal and coke. Coal is used in the converting furnace for heating the cases which contain the bar-iron during its process of cementation. In a properly-constructed furnace, one ton of good hard coal is consumed in the conversion of one ton of iron, thus representing a consumption of 40,000 to 50,000 tons per annum for this purpose. Coke is used in the melting process, the consumption being on an average 65 cwt. per ton of ingots. Although all iron is converted, and we can thus obtain the consumption of fuel, yet we have no means of exactly ascertaining the weight of cast-steel manufactured annually in England. I should estimate it at from 25,000 to 30,000 tons. This would give a consumption of 81,000 to 97,000 tons of coke; and assuming that the coal will produce 60 per cent. of coke, it will represent a consumption of 113,700 to 136,500 tons of coal.

In Germany, France and Austria, with trifling exceptions, steel is produced in a furnace similar to the charcoal refinery; it is termed raw or natural steel, deriving its carbon from the metal from which it is produced. Charcoal is the fuel used; the quantity is very variable, depending in a great measure upon the dexterity of the workman; we may, as a general average, estimate the consumption at 240 bushels per ton of raw steel produced.

Having laid before you an estimate of the raw materials used in the manufacture of steel, I shall now proceed to explain the processes which are used in various countries. The kinds of steel which are manufactured are—Natural steel, called raw steel or German steel; Paal steel, produced in Styria by a peculiar method; cemented or converted steel; cast-steel, obtained by melting cemented steel; puddled steel, obtained by puddling pig-iron in a peculiar way.

Natural or German steel is so called because it is produced direct from pig-iron, the result of the fusion of the spathose iron ores alone, or in a small degree mixed with the brown oxide. These ores produce a highly-crystalline metal, called *spiegle eisen—i.e.*, looking-glass iron—on account of the very large crystals the metal presents. This crude iron contains about 4 per cent. of carbon, and 4 to 5 per cent. of manganese. Karsten, Hassenfratz, Marcher, and Reamur, all advocate the use of grey pig-iron for the production of steel; indeed, they state distinctly that first-quality steel *cannot* be produced without it—that the object is to clear away all foreign matter by working it in the furnace, to retain the carbon, and to combine it with the iron. This theory I hold to be incorrect, although supported by such high authorities: grey iron contains the maximum quantity of carbon, and consequently remains for a longer time in a state of fluidity than iron containing less carbon; the metal is then mixed up, not only with the foreign matter it may itself contain, but also with that with which it may become mixed in the furnace in which it is worked. This prolonged working, which is necessary to bring highly-carbonised iron into a malleable state, increases the tendency to produce silicates of iron, which, entering into composition with the steel during its production, renders it red short. Again, by this lengthened process, the metal becomes very tender, and open in its grain; the molecules of silicate of iron which are produced will not unite with the true metallic part; and also, whenever the molecular construction of iron or steel is destroyed by excessive heat, it becomes unmalleable. Both these are the causes of red shortness, and also of the want of strength when cold. For these reasons I consider that grey pig-iron is by no means the best for producing natural steel; and, for the same reasons, I should not recommend the highly-carbonised white iron, although it is now used both in Germany and in France. In Austria, however, they have improved upon the general Continental process; their pig-iron is often highly carbonised, but they tap the metal from the blast-furnace into a round hole, and throwing a little water on the surface, they thus chill a small cake about half an inch; this is taken from the surface, and the same operation is performed until the whole is formed into cakes; these cakes are then piled edgewise in a furnace, are covered with charcoal, and heated for 48 hours: by this process the *carbon* is very much discharged. By using these cakes in the refining, the steel is sooner made, and is of better quality. In the opinions I have given to many German steel makers, and in the advice I have offered them, I have endeavoured to show that pig-iron can only be freed from its impurities whilst in a fluid state. I take the advantage of the property of cast-iron, and previous to melting it in the steel refinery, I submit it to a purification, by which process I seek to *reduce* the degree of carbonisation of the metal, and to separate and dissolve the earthy matter with which it may be combined; I then obtain a purer metal for the production of steel. The metal itself being to some extent decarbonised, is sooner brought into "nature," as it is termed; that is, it sooner becomes steel. The process being shorter, and the metal itself being purer, there is less chance or opportunity for the formation of deleterious compounds, which, becoming incorporated with the steel, seriously injure its quality. Of course, steel manufactured from crude iron, either purified or not, of any defined quality, will inherit such quality, be it good or bad. Art can in some degree remove these noxious qualities from the crude iron. Chemistry has lent its powerful assistance, yet nature will maintain her sway; and in all cases the good or bad qualities of the metal will be transmitted to the steel.

The furnaces in which raw or natural steel is manufactured are nearly the same, as far as regards their general construction, in all countries where such steel is produced; yet each country, or even district, has the fire in which the metal is worked differently constructed. We find, therefore, the German, the Styrian, the Carinthian, and many other methods, all producing steel from pig-iron, yet pursuing different modes of operation. These differences arise from the nature of the pig the country produces, and the peculiar habits of the workmen. These modified processes do not affect the theory of the manufacture, but they rather accommodate themselves to the peculiar character of the metal produced in the vicinity. In Siegen they use the white, carbonised, manganesian metal, whilst in Austria a grey or mottled pig-iron is used.

The furnace is built in the same form as a common charcoal refinery.

Fig. 1 shows a ground-plan of the furnace; Fig. 2, an elevation; and Fig. 3, the form of the fire itself and the position of the metal within it. The fire, D, is 24 inches long and 24 inches wide; A, A, A, are metal plates surrounding the furnace.

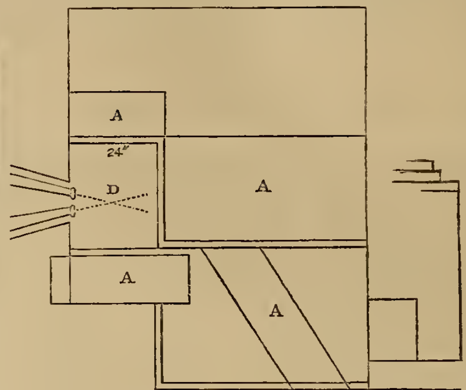


Fig. 1.

Fig. 2 shows the elevation, usually built of stone, and braced with iron bars. The fire, G, is 16 inches deep and 24 inches wide. Before the tuyere, at B, a space is left under the fire, to allow the damp to escape, and thus keep the bottom dry and hot.

In Fig. 1 there are two tuyeres, but only one tuyere-iron, which receives both the blast-nozzles, which are so laid and directed that the currents of air cross each other, as shown by the dotted lines: the blast is kept as regular as possible, so that the fire may be of one uniform heat, whatever intensity may be required.

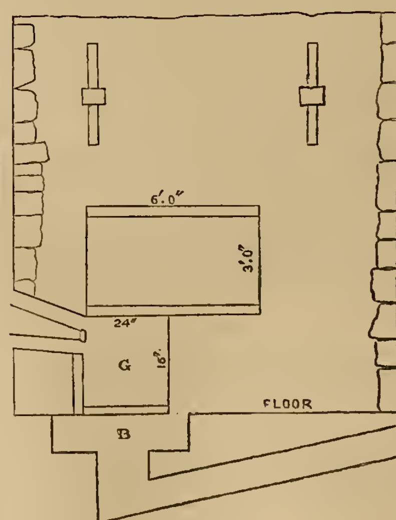


Fig. 2.

Figure 3 shows the fire itself, with the metal, charcoal, and blast. A is a bottom of charcoal, rammed down very close and hard. B is another bottom, but not so closely beaten down; this bed of charcoal protects the under one, and serves also to give out carbon to the loop of steel during its production. C is a thin stratum of metal, which is kept in the fire to surround the loop. D shows the loop itself in progress.

When the fire is hot, the first operation is to melt down a portion of pig-iron, say 50 to 70 lbs., according as the pig contains more or less carbon; the charcoal is then pushed back from the upper part of the fire, and the blast, which is then reduced, is allowed to play upon the surface of the metal, adding from time to time some hammer-slack, or rich cinder, the result of the previous loop. All these operations tend to *decarbonise* the metal to a certain extent; the mass begins to thicken, and at length becomes solid. The workman then draws together the charcoal, and melts down another portion of metal upon the cake; this operation renders the face of the cake again fluid, but the operation of decarbonisation being repeated in the second charge, it also thickens, incorporates itself with the previous cake, and the whole becomes hard; metal is again added until the loop is completed. During these successive operations, the loop is never raised before the blast, as it is in making iron, but it is drawn from the

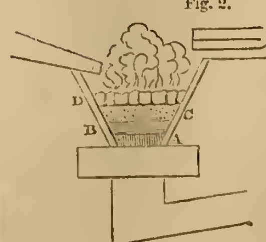


Fig. 3.

fire and hammered into a large bloom, which is cut into several pieces, the ends being kept separated from the middle or more solid parts, which are the best.

This operation, apparently so simple in itself, requires both skill and care. The workman has to judge, as the operation proceeds, of the amount of carbon which he has retained from the pig-iron: if too much, the result is a very raw, crude, untreatable steel; if too little, he obtains only a steelified iron: he has also to keep the cinder at a proper degree of fluidity, which is modified from time to time by the addition of quartz, old slags, &c. It is usual to keep from two to three inches of cinder on the face of the metal, to protect it from the direct action of the blast. The fire itself is formed of iron plates, and the two charcoal bottoms rise to within nine inches of the tuyere, which is laid flatter than when iron is being made. The position of the tuyere causes the fire to work more slowly, but it insures a better result.

The quantity of blast required is about 180 cubic feet per minute, at a pressure of 17 inches water-gauge. Good workmen make 7 cwt. of steel in 17 hours. The waste of the pig-iron is from 20 to 25 per cent., and the quantity of charcoal consumed is 240 bushels per ton. The inclination of the tuyere is 12 to 15 degrees. The flame of the fire is the best guide for the workman. During its working, it should be a red bluish colour. When it becomes white, the fire is working too hot.

From this description of the process, it will be evident that pig-iron will require a much longer time to decarbonise than the cakes of metal which have been roasted, as already described; and, again, it must be evident that a *purified* and *decarbonised* metal, such as I have proposed, must be the best to secure a good and equal quality to the steel, since the purified metal is more homogeneous than the crude iron.

When, therefore, care has been taken in melting down each portion of metal, and a complete and perfect layer of steel has been obtained after each successive melting—when the cinder has had due attention, so that it has been neither too thick nor too thin, and the heat of the fire regulated and modified during the progressive stages of the process—then a good result is obtained; a fine-grained steel is produced, which draws under the hammer, and hardens well. However good it may be, it possesses one great defect—it is this:—During its manufacture, *iron* is produced along with the steel, and becomes so intimately mixed up with it, that it injures the otherwise good qualities of the steel: the iron becomes, as it were, interlaced throughout the mass, and thus destroys its hardening quality. When any tool or instrument is made from natural steel, without it has been very well refined, it will not receive a *permanent* cutting edge: the iron part of the mass, of course, not being hard, the tool cuts only upon the steel portion; the edge very soon, therefore, becomes destroyed. There is another defect in natural steel, but it is of less importance. When too much carbon has been left, the steel is raw and coarse, and it draws very imperfectly under the hammer; the articles manufactured from such steel often break in hardening: thus, it is evident that in producing the steel, every care, skill, and attention are required at the hands of the workman. These defects very materially affect the commercial value of the steel; the irregular quality secures no guarantee to the consumer that the tools shall be perfect, and, consequently, it is not used for the most important purposes; yet, where the raw steel is refined, it becomes a very useful metal, and is largely used in Westphalia for the manufacture of hardware, scythes, and even swords. It possesses a peculiarity of retaining its steel quality after repeated heating, arising from its carbon being, as it were, incorporated with *each* molecule of the mass. This property renders it very useful for mining and many other purposes.

The raw steel, being so imperfect, is not considered so much an article of commerce with the manufacturer, but it is sold to the steel-refiners, who submit it to a process of welding. The raw steel bloom is drawn into bars, one or two inches wide and half an inch thick, or less; a number of these are put together and welded: these bars are then thrown into water, and they are broken in smaller pieces to examine the fracture; those bars which are equally steelified are mixed together. In manufacturing refined steel, the degree of hardness is selected to suit the kind of article which it is intended to make. A bar, two to three feet long, forms the top and bottom of the bundle; but the inside of the packet is filled with the small pieces of selected steel. This packet is then placed in a hollow fire, and carefully covered from time to time with pounded clay, to form a coat over the metal, and preserve it from the oxidising influence of the blast. When it is at a full welding heat, it is placed under a hammer, and made as sound and homogeneous as possible; it is again cut, doubled together, and again welded. For very fine articles, the refining is increased by several doublings; but this is not carried at present to so great an extent as formerly, since cast-steel is substituted, being in many cases cheaper. Although the refined natural steel is very largely consumed in Germany, and also in Austria, yet a considerable quantity is exported to South America, the United States, and to Mexico. The Levant trade takes a large portion, and is supplied from the Styrian and Carinthian forges. This is shipped from Trieste; it is sold in boxes and bundles. That in boxes is marked No. 0 0, up to 4. The 0 0 is the smallest, being about ¼ inch square; number 4 is about ½ inch; 0, 1, 2, and 3, being the intermediate sizes. It is broken in small pieces, about 3 to 7 inches long. In bundles of 100 lbs. the steel is drawn to various sizes, and is so packed. A large portion is sent to the East Indies, and also to the United States. For this kind of steel Halbach enjoys a high reputation, also Hassenclever, both Westphalian manufacturers.

The average price of that sold in boxes is £20 to £24 per ton; in bundles, £17 to £20; and the raw steel, as sold to the refiners, £15 to £18 per ton: whilst the refined steel increases in price according to the number of times it has been refined.

I take the manufacture of puddled steel as next in order, because the product is similar to that of natural steel, that being obtained direct from the crude pig-iron. It is a steel of very recent invention, and its manufacture is carried on entirely in Westphalia. But a few years ago, a very small quantity of this steel was produced from *one* work. There are now several large establishments for its manufacture. The produce is becoming considerable, and likely to increase on account of its cheapness.

The object of the operation is similar to that adopted in the making of raw steel, to decarbonise pig-iron down to that point at which it can be treated as steel. The process is this:—About 280 lbs. of pig-iron are charged into a puddling furnace. As soon as this metal begins to melt, the damper is partly closed, and 12 to 16 shovelsful of cinder, &c., as it comes from the hammer and rolls, are thrown into the furnace; the whole is then melted down together, and the mass is puddled with great care. The metal having become so far decarbonised as to lose its liquidity, the damper is opened, and 40 lbs. of pig-iron are charged near the fire-bridge of the furnace. This is allowed gradually to melt and mix itself with the metal previously charged, which causes it to boil; a blue flame rises from the surface of the mass, and very shortly the metal stiffens. The damper is again three-quarters shut, and the mass is worked until it becomes waxy. The metal is then collected into balls, and hammered into blooms. This steel is very imperfect; too much depends upon the manipulation of the process; it is out of the sight of the workman, and equally from under his control, being continually covered with cinder. Practice has, no doubt, assisted materially in the improvements made in the manufacture of this steel since its introduction, but it is evident that steel produced by such a process can only be serviceable for the commonest purposes, being subject to many serious imperfections. The blooms resulting from the process described are drawn, doubled, and welded precisely in the same manner as charcoal raw steel is refined; yet, such is the acknowledged inferiority of this steel, that whilst charcoal natural steel sells for £18 per ton, the puddled steel will not command more than £14 per ton; and an equal reduction is made on the refined steel manufactured from puddled steel blooms.

The next process is the Paal method, so called from the name of the works at which the plan is used. These works belong to Prince Schwartzenberg, and are situated near to Murrau, in Styria. The process is based upon the old one of Vanaccio; it consists in plunging iron into a bath of melted metal. The carbon of the metal combines with the iron, and in a very short time converts it into steel. This process was carried further by Vanaccio, who contrived to add wrought-iron to the metal until he had decarbonised it sufficiently; this was found to produce a steel, but unfit for general use. That produced by plunging iron into metal was found to be very hard steel on the outside, but iron within; while that produced by adding iron to the metal was found too brittle to be drawn. The Paal method, however, as I saw it used at these works, is a decided improvement in the manufacture of refined natural steel. They produce natural steel at the Prince's various works, and bring it to Paal to be refined. The packets, as already described in the refinement of natural steel, are welded and drawn to a bar; whilst hot, they are plunged into a bath of metal for a few minutes, by which the iron contained in the raw steel becomes carbonised, and thus a more regular steel is obtained than that produced by the common process. The operation requires great care; for if the bars of steel be left in the metal too long, they are more or less destroyed, or perhaps entirely melted. It commands a little higher price in the market, and is chiefly consumed by the home manufacturers, excepting a portion which is exported to Russia.

I have now described the manufacture of steel by various processes, in all of which the carbon is derived from the metal itself, and in which the whole of the molecules of the metal may be said to be equally charged; they contain the necessary amount of carbon, or steelifying principle, within themselves, and to this may be attributed the reason why, after repeated heating and hammering, the steel never loses its property of hardening. On this account, natural steel is used almost exclusively by the Mexican and South American miners for their tools.

I shall now turn to the second mode of producing steel, by introducing carbon into iron to such an extent as may be needful for the various purposes to which it is to be applied.

In explaining the theory and practice of manufacturing natural steel, I have shown that the object is to prevent the mass from becoming iron, the process being arrested at that point where the metal has lost so much of its carbon that the *remainder* is necessary for it to possess as a steel.

The process of converting iron into steel by cementation is the reverse of the process already described. The iron to be converted is placed in a furnace stratified with carbonaceous matter; and on heat being applied, the iron absorbs the carbon, and a new compound is thus formed.

When this process was discovered is not known. At a very early period, charcoal was found to harden iron, and make it a sharper cutting instrument; it seems probable that from the hardening of small objects, bars of iron were afterwards submitted to the same process. To Reamur certainly belongs the merit of first bringing the process of conversion to any degree of perfection. His work contains a vast amount of information upon the theory of cementation; and although his investigations are in many instances not borne out by the practice of the present day, yet the *first* principles laid down by him are now the guide of the converter. Our furnaces are much larger than those used by Reamur, and they are built so as to produce a more uniform and economical result: they give, however, precisely the same results which he obtained in his small ones.

A converting furnace consists simply of two troughs, built of fire-brick, 12 feet long, 3 feet wide, and 3 feet deep; the fire-room is placed between them, and the whole covered by an arched vault, so that the heat may pass entirely around these troughs, and distribute itself equally. The bar-iron is placed within these troughs, stratum superstratum along with charcoal, which is broken to the size of beans. When the troughs are full, they are covered with sand or loam, which partially vitrifies and cakes together as the heat of the furnace increases, and thus, by hermetically sealing the top, the air is excluded. This furnace being charged with about 20 tons of iron, the fire is lighted, and in the course of 60 to 70 hours the iron will have become fully heated; *at this point the conversion commences*. The pores of the iron being opened by heat, the carbon is gradually absorbed by the mass of the bar; but the *carbonisation* or conversion is effected, as it were, in layers. To explain the theory in the clearest manner, let me suppose a bar to be composed of a number of laminæ—the combination of the carbon with the iron is first effected on the surface, and gradually extends from one lamina to another, until the whole is carbonised. To effect this complete carbonisation, the iron requires to be kept at a considerable uniform heat for a length of time. Thin bars of iron are much sooner converted than thick ones. Reamur states, in his experiments, that if a bar of iron 3-16ths of an inch thick is converted in six hours, a bar 7-16ths of an inch would require 36 hours to attain the same degree of hardness. The carbon introduces itself *successively;* the first lamina or surface of a bar combining with a portion of the carbon with which it is in contact, gives a portion of the carbon to the second lamina, at the same time taking up a fresh quantity of carbon from the charcoal; these successive combinations are continued until the whole thickness is converted: from which theory it is evident that from the exterior to the centre the dose of carbon becomes proportionately less. Steel so produced cannot be said to be perfect; it possesses, in some degree, the defect of natural steel, being more carbonised on the surface than at the centre of the bar. From this theory we perceive that steel made by cementation is different in its character from that produced directly from crude metal. In conversion the carbon is made successively to penetrate to the centre of the bar, whilst, in the production of natural steel, the molecules of metal which compose the mass are *per se* charged with a certain percentage of carbon necessary for their steelification; not imbibed, but obtained by the decarbonisation of the crude iron down to a point requisite to produce steel.

During the process of cementation, the introduction of the carbon disintegrates the molecules of the metal, and in the harder steel produces a distinct crystallisation of a white silvery colour. Wherever the iron is unsound or imperfectly manufactured, the surface of the steel becomes covered with blisters thrown up by the dilation of the metal and introduction of carbon between those laminæ which are imperfectly melted. Reamur and others have attributed this phenomenon to the presence of sulphur, various salts, or zinc, which dilate the metal; but this is incorrect, because we find that a bar of cast-steel which is homogeneous and perfectly free from internal imperfections never blisters; for although it receives the highest dose of carbon in the furnace, yet the surface is perfectly smooth. From this it is evident that the blisters are occasioned by imperfections in the iron. Iron increases, both in length and weight, during conversion. Hard iron increases *less* than soft. The augmentation in weight may be said to be $\frac{1}{200}$, and in length $\frac{1}{120}$, on an average.

The operation of conversion is extremely simple in its manipulation; nevertheless, it requires great care, and a long as well as a varied experience, to enable a manager to produce every kind or temper required by consumers. Considerable knowledge is required to ascertain the nature of the irons to be converted, because all irons do not convert equally well under the same circumstances; some require a different treatment from others, and, again, one iron may require to be converted at a different degree of heat from another. The furnace must have continual care, and be kept air-tight, so that the steel, when carbonised, may not again become oxidised. Generally speaking, in working converting furnaces, but little attention is paid to the theory of producing steel, which I have endeavoured to explain. It is known amongst steel-makers, that if iron be brought in contact with carbon, and if heat be applied, it will become steel. This is the knowledge gleaned up by workmen, and I may add, by too many owners of converting furnaces. The inconvenience arising from a want of care and knowledge of the peculiar state of the iron *during* its conversion, sometimes occasions great disappointment and loss. The success usually attained by workmen may, however, be attributable to an everyday attention to one object, thus gaining their knowledge from experience alone,—good, I admit, in a workman, but this should not satisfy the principal or manager of a steel-work. It is, perhaps, not needful that he should be a man of science; but I consider it the duty, as it certainly is the interest, of every owner of such works, not only to satisfy himself, but to be able to convince the minds of others, that he is fully conversant with the cause and effect of every operation in his business; and although a knowledge of chemistry may throw much light upon his operation, it is also necessary that he should possess a varied experience in conjunction with it, before he can pretend to produce steel of such superior and uniform quality as the arts require. The conversion or carbonisation of the iron is the foundation of steel-making, and, as such, may be considered as the first step in its manufacture. Before bar-steel is used for manufacturing purposes, it has to be heated, and hammered or rolled. Its principal uses are for files, agricultural implements, spades, shovels, wire, &c.; and, in very large quantities, for coach-springs.

Bar-steel is also used for manufacturing shear-steel. It is heated, drawn to lengths 3 feet long, then subjected to a welding heat, and some six or eight bars are welded together precisely as described in the refinement of natural steel; this is called single shear. It is further refined by doubling the bar, and submitting it to a second welding and hammering; the result is a clearer and more homogeneous steel. During the last seven years, the manufacture of this steel has been limited, mechanics preferring a soft cast-steel, which is much superior when properly manufactured, and which can be very easily welded to iron.

The price of bar-steel varies according to the price of the iron from which it is made; but, as a general average, its price in commerce may be taken at £5 per ton beyond the price of the iron from which it is made. Bar-steel produced from the better irons is usually dearer than the commoner kind, on account of their scarcity.

Shear-steel in ordinary size sells at	£60	per ton net.
Coach-spring steel from foreign iron	22	,,
Coach-spring steel from English iron	18	,,

These may be taken as approximate prices in 1854-5.

From the outline which I have given of the processes by which various steels are manufactured, it will be seen that there are in each great defects, want of uniformity, temper, or clearness of surface, unfitting them for many useful purposes. To obviate these defects, both bar converted and also raw steel are *melted,* by which the metal is freed from any deleterious matter which the iron might have contained; a uniform and homogeneous texture is obtained, whilst an equality in temper or degree of hardness is secured: besides which, the surface is capable of receiving a high, clear, and beautiful polish,—qualities which the other steels I have described do not possess. The first steel which may be called cast-steel is the celebrated wootz of India; it is produced by mixing rich iron ore with charcoal in small cups or crucibles. These are placed in a furnace, and a high heat is given by a blast. After a certain time this ore melts, and receives a dose of carbon from the leaves and charcoal charged with it. The result is a small lump of metal with a radiated surface about the size of a small apple cut in two; it is very difficult to work; nevertheless, swords and other steel implements are manufactured from it in the East: it is not found in England as an article of commerce. The melting of bar-steel was first practically carried out by Mr. Huntsman, of Attercliffe, near Sheffield, whose son yet carries on its manufacture, for which he enjoys a very high celebrity, by making use of the best materials, and insisting upon the most careful manipulation of his steel in every process. The manufacture of cast-steel is in itself a very simple process. Bar-steel is broken into small pieces, which are put into a crucible, and are melted in a furnace, about 18 inches square and 3 feet deep. The crucible is placed on a stand 3 inches thick, which is placed on the grate-bars of the furnace. Coke is used as fuel, and an intense heat is obtained by having a chimney about 40 feet high. Although a very intense white heat is obtained, yet it requires $3\frac{1}{2}$ hours to perfectly melt 30 lbs. of bar-steel. When the steel is completely fluid, the crucible is drawn from the furnace, and the steel is poured into a cast-iron mould. The result is, an ingot of steel, which is subsequently heated and hammered, or rolled, according to the want of the manufacturers. Although I stated that the melting of cast-steel is a simple process, yet, on the other hand, the manufacture of cast-steel suitable for the *various wants* of those who consume it requires an extensive knowledge; a person who is capable of successfully conducting a manufactory, must make himself master of the treatment to which the steel in manufactures will be submitted by every person who consumes it. Cast-steel is not only made of many degrees of hardness, but it is also made of different qualities; a steel-maker has, therefore, to combine a very intimate knowledge of the exact intrinsic quality of the iron he uses, or that produced by a mixture of two or three kinds together: he has to secure as complete and as equal a degree of carbonisation as possible, which can only be attained by possessing a perfect practical and theoretical knowledge of the process of converting; he has to know that the steel he uses is equal in hardness, in which, without much practice, he may easily be deceived; he must give his own instruction for its being carefully melted, and he must examine its fracture by breaking off the end of each ingot, and exercise his judgment whether or not proper care has been taken. Besides all this knowledge and care, a steel-maker has to adapt the *capabilities* of his steel to the *wants* and *requirements* of the consumer. There are a vast variety of defects in steel as usually manufactured; but there are a far greater number of instances in which steel is *not adapted* for the manufacture of the article for which it was expressly made. Cast-steel may be manufactured for planing, boring, or turning tools; its defects may be, that the tools when made crack in the process of hardening, or that the tool, exceedingly strong in one part, will be found in another part utterly whilst useless.

Cast-steel may be wanted for the engraver. It may be produced apparently perfect and with a clear surface, but may be so improperly manufactured, that when the plate has been engraved and has to be hardened, it is found covered with soft places. The trial is even greater when the engraving is transferred by pressure to another plate. I might cite a vast number and variety of instances in which cast-steel is manufactured by unskilful persons, and, for want of a proper knowledge of the treatment which the steel will receive after it has left his control, it is found more or less *unsuitable.* It is, therefore, evident that a steel-maker must not only attend to the intrinsic quality of his steel, but he has to use his judgment as regards the degree of hardness and tenacity which it should possess, so as to *adapt it to the peculiar requisites of its employment.* Now, as to the prevention of the defects I have mentioned, although it is a task requiring much practical knowledge, yet it is attained by many who, having combined a knowledge of their own business with that of their customers, have gradually earned for themselves a deserved reputation.

The manufacture of cast-steel is open to great temptations, which may be termed fraudulent. Swedish iron, as I have already stated, varies in price according to its usefulness for steel purposes; cast-steel may, therefore, be manufactured from a metal selling at £20 a ton, whilst the price charged for it to the consumer presumes it to have been made from a metal worth £30 per ton. The exterior of the bar is perfect, the fracture appears to the eye satisfactory, and its intrinsic value is only discovered when it is put to the test: thus, whilst a steel-maker has to exercise his knowledge, judgment, and care, he has a moral duty to perform, by giving to his customer a metal of the intrinsic value he professes it to be, and for which he makes his charge.

In manufacturing the commoner descriptions of steel, particularly cast-steel made from English iron, oxide of manganese has been largely used; its use produces malleability to a common metal, and the effect upon the steel during the operation of melting has been a subject of much speculative discussion, not only amongst scientific men, but also at the bar. The great question of the late Mr. Heath's patent is now before the House of Lords for their final decision. I cannot agree with any of the causes which have been set forth during the various discussions in the courts of law, as producing the effect every day obtained. I find no alloy of metallic manganese with steel, and certainly the very small quantity of carbon which the oxygen of the manganese takes up affects the degree of hardness very slightly.

I have examined this interesting matter, and in doing this I have set up no theory of my own, but I have carefully examined the scoria or slag produced, when oxide of manganese was used, and when it was not; the metal also has been carefully weighed before and after melting. In my experiments I used English iron, which is so coarsely manufactured that it is mixed up with much deleterious matter. In more nicely investigating this subject, I used a Swedish iron, which contained a large amount of silicate of iron. I charged two crucibles each with 30 lbs. of this Swedish metal properly converted into steel. Into one I put 3 per cent. of oxide of manganese—into the other nothing. Both crucibles were in one furnace, and melted down in about the same length of time. In the crucible containing the oxide of manganese I got more slag and a little less metal than in the other. The ingot melted with manganese drew very sound under the hammer; the other was filled with cracks. On an examination of the metal and the slag resulting from each crucible, I found that the oxide of manganese had attacked and dissolved all the silicate of the metal it could find, as the metal gradually melted, and converted it, with other deleterious matter, into a glassy slag, which was very fluid. The steel being thus freed from these noxious matters, is precipitated by its own gravity, and the molecules of metal coming in closer contact by the removal of the foreign matter, which before more widely divided them, the metal is of greater density, and becomes very malleable under the hammer. There have been various attempts to produce a cast-steel from the rich iron ores by converting them and subsequently melting; but although cast these can, of course, be so obtained, yet it has no defined temper or steel quality. Charcoal also has been added to bar-iron cut into small pieces; but although steel is thus obtained, the same ingot produces several different degrees of hardness, and sometimes ingots of no value whatever. The experiments of Cluoet, Mushet, Briant, and others, have equally been productive of no useful result.

I have endeavoured in the foregoing to give a clear, and at the same time a condensed description of the raw materials required, and the processes used, in the manufacture of each kind of steel found in commerce, either in England, the Continent of Europe, or America, which concludes the first part of this essay.

(To be continued.)

DESTRUCTIVE WAR MISSILES.

[Our Liverpool Correspondent has forwarded the following communication, describing designs which we think possess novelty and ingenuity enough to warrant us in presenting them to our numerous readers; and although we do not affect to be learned in military matters, we cannot permit the insertion of this communication without observing, that if the external projections could not be dispensed with, they would preclude the use of these missiles, as no accuracy of flight could be insured, nor could they be fired from a bore of any length without injuring it, as there is always a tendency in spherical shot, &c., to turn in the gun whilst being projected therefrom: but the following communication may be serviceable in directing the attention of those engaged in conducting the practical operations of the present war, and who, we hope, desire to introduce any practical improvements which can be made in projectiles.—Ed.]

Mr. William Cookson, of Liverpool, a foreman of moulders, communicated to the writer, in July, 1855, that he had an idea that it was practicable to load shells with molten metal, which, on being projected against an enemy's ship or building, would break, and allow the fluid metal to destroy anything capable of destruction by fire, with which it might come in contact. The following description is to show how the writer proposes to put this idea into a practical shape for trial, and what effects such a projectile would probably cause.

The accompanying drawings are so clear, as to render a *literal* description unnecessary. The first projectile consists of two hemispheres of cast-iron, united by a bolt passing through them, secured by a nut and eye, through which a bar is passed, first, to screw up the halves of the shell—secondly, to carry and raise it into the mortar. A door is cottered down on the opening, by which the shell is filled with metal. The white space represents loam or fire-clay applied to the interior of the shell, just as it is applied to the "ladle" of the iron-founder; to facilitate the application of which, the shell is constructed in two pieces, "strickles," or ends of iron wire projecting into the interior, to hold securely the loam or clay, by which the shell is prevented from being melted, or cracked by the hot metal—represented by the dark ground—suddenly coming into contact with it. The white space round the bolt represents fine sand, poured in through the annular space at the point of the bolt, before the eye and nut are "shipped" on, to prevent the bolt from becoming hot and expanding. Tubular projections are cast on each part of the shell, to facilitate the junction, to "stay" the shell at the moment of discharge, and to retain the sand round the bolt.

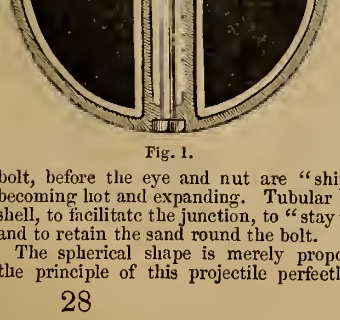


Fig. 1.

The spherical shape is merely proposed as rendering the explanation of the principle of this projectile perfectly simple. *Experiment* is necessary to determine whether the shell would not be better constructed if made in two pieces, but not hemispherical—the inferior part, for instance, being made two-thirds of the diameter in depth, the length or circumference of the joint being lessened, and the joint kept clear of the bore of the mortar,—or if it were made to approximate in shape to a champagne-bottle, or to a cylinder. *Experiment* must also determine the thickness of metal that will resist the shock of the powder, on the discharge of the mortar, and yet will allow the shell to be fractured by the shock, caused by projection against, and contact with ship, building, or side of embrasure. To prepare the shell for action, the inside is daubed with loam and well dried, the bolt is tightly screwed up, the door is removed, and the hot metal put in: when full, a lump of clay must be dashed on the aperture, and the door forcibly pressed and cottered down; the eye on the nut may then be used to pass a bar through, by which the shell may be transported and lifted into the mortar.

The writer proposes also to load shells with red-hot balls of three-quarters or one inch diameter. The accompanying sketch sufficiently shows the manner of doing so; the stopper serving both to close the shell, and facilitate the transport of it to the guns or mortars. *Experiment* must also determine whether, when loaded with balls of three-quarters or one inch diameter, red-hot, such a shell would not cause more loss to life, limb, and property, than one solid hot shot; the advantage supposed being, that the action of the shell so loaded would be more diffusive than that of a red-hot ball, and that the same weight of small shot could be more easily heated than the same weight comprised in one bulk. This may be used simply as a means of loading a gun with red-hot balls, the case being so thin as to be blown to pieces by the explosion of the powder, and would possess this advantage over the ordinary cold discharge of grape—that, used against troops, they would be *blown* up, as well as *cut* up, if the balls got into their cartridge-boxes.

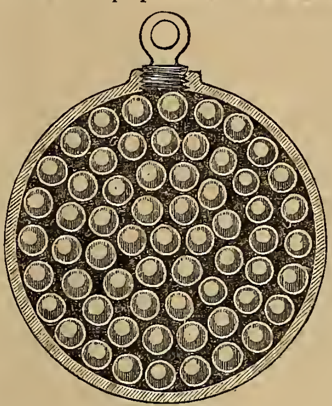


Fig. 2.

The writer proposes to call this projectile the *Silent Shell*, in contradistinction to the explosive shell, from which it differs so essentially in principle. The cast-iron case of the latter is the destroying agent; being employed, first, as the carrier of the powder to a certain point; on arriving at which, the powder contained in it is exploded by the fusee. In the proposed projectile, the *case* is simply the carrier of the destroying agent, *i. e.*, the hot metal. Suppose such a shell smashing into an embrasure or against a gun: any one who is practically acquainted with cast-iron may conceive the blinding, burning shower that would drive every man from his post who happened to be near. Suppose that one, two, three shells broke in succession near the same spot—let it be remarked that the effect would continue considerably longer than just after the fall—the action would cease, not, as with the ordinary shell, simultaneously with the explosion, but with the cooling of the metal in ten minutes or half an hour, according to the concentration of the fire and to the diffusion of the contents of the shell: if the contents be much scattered, of course it will cool soon. The ironfounder may realise the *éclatant* effect of the breaking of such a shell against a bulwark or an embrasure, by causing some half-dozen pounds of metal to be poured into the pit of his foundry from a height of, say, six feet. Lodged in a ship's side or cabin, it is not easy to imagine how the surrounding timber could escape ignition. The proposed method of loading shells possesses another considerable advantage: every pound of cast-iron that came from an enemy's gun might be returned to him, *viâ* portable cupola, or air-furnace; that *sine quâ non* now required in preparing our shot, uniformity of diameter, would no longer operate in favour of hostile uniforms—uniformity of temperature would alone be desirable. The principle of the shell being admitted useful—experiment having shown that the principle can be substantially carried into practice—it remains to consider what are the best means to supply hot metal: to effect this, however, is merely to select from many known plans, already in satisfactory execution, that one best suited to the peculiar requirements of the case.

STEAM-BOILER EXPLOSIONS.

Recently several cases of steam-boiler explosions have occurred, attended with loss of lives. The two most recent cases are in Sheffield, viz., those at the Tower Mills, and at the Hartford Steel Works.

Of these explosions we can do no more at the present time than describe them in a popular and somewhat hurried manner, as we shall not be able to complete the diagrams and our investigations in time for publication in the present number, but will present the cases in their proper form in our next.

THE TOWER MILLS.

The Tower Mills is an extensive building, divided into compartments, which are occupied by grinders connected with the different Sheffield trades. The machinery is driven by six engines, and two boilers have hitherto supplied the motive power to the engines. Within the last few weeks, however, the proprietors, Messrs. W. Parker and Co., with a view the better to comply with the requirements of the by-law for the consumption of smoke, have put down a third boiler. It was this new boiler which exploded, while being tested during the evening of Saturday, the 11th of August. Henry Alcock had the superintendence of the testing of the boiler, and it was his intention to carry the test to a pressure of 80 lbs. to the square inch. The boiler was guaranteed to bear a pressure of 90 lbs. When the steam reached 75 lbs. pressure, Alcock prepared to blow it off, but some few moments' delay took place, owing to the waste-pipe not having been affixed, and before the safety-valve had been lifted the explosion took place, accompanied by a terrific report. The boiler, which was a double-flue one, 24 feet long, 7 feet in diameter, and weighed 10 tons and a half, was raised from its bed, and projected, like a cannon-ball, through the gates of the main entrance, near which it was fixed, across Blouk-street, and through several buildings on the opposite side, falling into the river Don, which runs at the foot of the more distant of the buildings. The gates were smashed to pieces, and the buildings with which the boiler came in contact were almost entirely demolished. The distance from the bed of the boiler to its resting-place in the river is about fifty yards. How much further the boiler would have been carried if it had not met with such formidable obstructions, it is impossible to say; but so violently did it strike the buildings, that a number of bricks were driven against a wall on the opposite side of the river and completely powdered, as is shown by the marks still on the wall. One end of the boiler was blown out, and one of the flues collapsed nearly the whole length. The most melancholy part of the story, however, was the loss of life occasioned by the disaster. Samuel Hill, who was standing in front of the boiler, was carried into Blouk-street, where he was picked up in a sadly mutilated state, and died in a few minutes afterwards. Broughton and Marriott (a looker-on) were struck down, and sustained fractures of the ribs and internal injuries, from which they died, Broughton the same evening, and Marriott on the Monday morning following. Alcock, who was standing upon the boiler at the moment of the explosion, was afterwards taken out of the hollow whence the boiler had been moved, very seriously scalded and otherwise injured: he was conveyed to the Infirmary, and died of his wounds on the Thursday evening following. Mr. Hutton, an engineer, who was present as a spectator, sustained a compound fracture of the arm; and several other persons were somewhat severely injured, but they are all progressing favourably.

An inquest was held upon the bodies of the four persons killed by the explosion, which investigation was brought to a close on Friday evening, the 17th August. The persons killed are—Henry Alcock, millwright and engineer; Samuel Hill and John Broughton, engine-tenters; and John Marriott, blacksmith. The survivors appeared before the jury, and several of them gave positive evidence that there was sufficient water in the boiler at the time of the explosion, stating that they observed the water-gauge but a very short time previously. An engineer, who had been deputed by the coroner to examine the boiler, &c., with a view to ascertain the cause of the disaster, was of opinion that the indication of a sufficient quantity of water being in the boiler when the accident occurred, had either misled or been misunderstood by those engaged in the test; that the water had got so low as just to bare the top of one of the fire-flues, which had in consequence become hot, and generated steam with extreme rapidity as the boiling water waved over or upon it; and that this slight deficiency of water, by so rapidly generating steam, had caused the explosion; and added—"I cannot close without offering my opinion as to the careless manner in which such dangerous apparatus are too frequently treated, but more particularly is it reprehensible for men to be allowed to experiment or test steam-boilers unless they are experienced." The verdict of the jury was, "That the boiler at Tower Mills exploded in consequence of the excessive pressure to which it was subjected, in being tested in an injudicious manner by persons not sufficiently competent for that purpose: we therefore return a verdict that Samuel Hill, John Broughton, John Marriott, and Henry Alcock have come to their deaths by accident."

The second of these boiler explosions occurred on Saturday morning, the 18th of August, at 10 minutes before 7 o'clock; and, curiously enough the scene of this disaster, the Hartford Steel Works, adjoins the Tower Mills, where the terrific boiler explosion occurred on the previous Saturday.

These steel works are the property of Messrs. Shortridge, Howell, and Jessop, the latter of whom sat as a juryman on the inquiry into the circumstances of the explosion at the Tower Mills. The rolling mills of the Hartford Steel Works occupy a compartment about 50 yards long. One end of the compartment abuts upon the Tower Mills, and at the other end is an immense brick chimney, one of the loftiest and finest in the town. The boiler which has exploded was situated at the foot of this chimney, the end containing the furnace being towards the Tower Mills. The boiler was 40-horse power, and was used to drive two engines—one of 30 and the other of 6 horse power, which worked the machinery of the rolling mills. The boiler was made by Mr. Thomas Arnold, of Harmer-lane, and had been in operation two years within about a month. It appears that James Cawthorne, the engine-tenter, got on the steam at the usual hour on Saturday morning, and commenced running at 6 o'clock. Operations went on in the ordinary way, the steam in the boiler being at the usual pressure of 40 lb. to the square inch, until 10 minutes to 7 o'clock, when a rupture took place in the ends of the boiler, and a furious hissing of steam ensued. This lasted but from one to two minutes, when the boiler exploded with a terrific report. The boiler was burst near the middle, and a large portion of the upper part was torn away from the remainder, and carried through an archway into the converting furnaces, on the left hand, a distance of about 20 yards, carrying away a large portion of the partition-wall in its course. Other parts of the boiler, and the grate and brick, were projected up the mills and on both sides in every direction. The mills present a scene of devastation. The roof, which consisted of slates, with a breadth of glass up the centre of each slope, for a distance of 20 yards, was brought to the ground; and the woodwork, slates, and glass of the remainder were broken and torn in every direction, especially up the centre. An immense water-tank, which rested upon an elevation of brickwork, was lifted from its resting-place and dashed to the ground, and large masses of iron and machinery were hurled from their places all round the boiler adjoining the mills. On the right-hand side are a number of cottage-houses, and the violence of the explosion dashed down the mill-walls at that point, and drove in large masses of the walls of the cottages. Fortunately, the houses were unoccupied, Messrs. Shortridge, Howell, and Jessop having recently given the tenants notice to quit, with a view to taking down the cottages for the purpose of enlarging the works. No damage has been done to any other part of the works, nor has the fine chimney been in the least disturbed.

The most melancholy result of the explosion, however, was the loss of life and the personal injury it has occasioned. At the time the issue of steam commenced, there were about the boiler and in other parts of the mills about twenty youths and men at work; and had the boiler exploded without giving any warning, the sacrifice of life would, in all probability, have been very great. Immediately the rush of steam took place, both men and boys suspected what was going to follow, and instantly sought safety in flight. Fortunately, there were several openings into other parts of the works along the side of the rolling mills, which afforded them ready egress, and most of the persons escaped without the slightest injury.

A youth named George Bennett, employed as a backer, standing about 15 yards from the boiler, apparently not all apprehensive of danger, was struck by the falling roof, was fearfully crushed, and died in a few minutes after being picked up.

James Cawthorne, the engine-tenter, was struck over the ancle just as he was passing out at the end of the building, and injured to some extent, but not seriously.

A youth named Charles Argyle, who was employed as a sweeper, was much more seriously injured.

William Bennett (brother of the deceased), employed as a straightener, was struck on the head. The only other person who was injured, so far as we have learnt, is an elderly man named George Robinson, whose head was slightly cut by a piece of glass which fell upon him. Alfred Handley and several others, who were close beside the engine, escaped unhurt.

The engine-tenter attributes the explosion to the giving way of the gusset stays at one side. Those on the opposite side were repaired a fortnight previously. The boiler was a multitubular one.

We shall have the pleasure of presenting to our readers, in our next, accurate drawings of the boilers, exhibiting their respective states both before and after the explosions.

CANALS AND RAILWAYS IN INDIA.*

By W. Bridges Adams.

(Concluded from page 191.)

[Mr. Adams then went on to describe the construction of wheels on railways, and their defects, and the essential principles of their improvement. He thus continued:—]

It is a common remark by persons of not very logical minds, that a thing is very well in theory, but will not do in practice. If this mean anything, it is that the theory is a false one. A man putting forth a false theory may do so either honestly or ignorantly, and in neither case ought he to be implicitly trusted; but precisely the same remark applies to those who refuse to admit a true theory, or who suffer a true theory to fall dead for want of application. To the clear perceptive mind the true theory is as true and certain as the demonstration by practice.

To illustrate the theory of rails which I have set forth, the large model on the table represents a rail of girder form, deep and wide, to give vertical and horizontal strength. The top of the rail is elevated less than 3 inches above the bearing on the ballast, while the width is 13 inches, or a proportion of about 26 to 5 in favour of steadiness. The total depth of the rail is 7 inches; and of this $4\frac{1}{2}$ inches serve as a keel, to give additional steadiness by holding laterally in the ballast. The tie-bars keep the gauge. The packing is very accessible, and the rail is really reversible. The rails and side brackets break joint mutually, and the manufacture is easily producible, and any part can be replaced without much waste. There are but four parts or types, and the commonest labourers can lay them down without error, while the whole is of wrought-iron, and there is no timber to rot, and no mechanical work to do on the ground.

There are three other models—one of a bracket-joint for a double head-rail, increasing the mechanical efficiency and decreasing the cost; a second model of a similar joint for a mid-ribbed rail, to give lateral stiffness and resistance. The third is a girder rail and joint, to be applied to cross sleepers or to detached blocks. This rail is very stiff, both vertically and laterally. All these are applicable to locomotive lines.

The bridge rail and joint with the tie-bar are applied for laying down on the surface of the ground, or for cross sleepers. The rail is rolled with two lower

* Abstract of Paper read before the Royal Society of Arts.

ribs forming angles, over which the sides are drawn close by the bolts, clipping both rails and tie-bar as firmly as a vice. The rail is thus deepened vertically, and rendered stiffer. The gauge is shown as 2 feet 6 inches. The rail is adapted to lay down without sleepers on the surface of the ground, and may be easily widened by longer tie-bars. There is no timber or sleeper needed, and the rails may be moved at a moment's notice. The firmness of the joints makes the rails practically continuous bars. This rail is perfectly well adapted for horse traction, burying the joints in the ground, and leaving the rails to bear on the surface, or placing detached blocks of wood below them. The waggon-wheels are to be cast sheaves, from 15 to 18 inches in diameter, and a single spring connecting the ends of the axles together on each side. The waggons will carry a load of 30 cwt.; or a lighter rail, on the same principle, may be used to carry 15 cwt. This same rail and joint increased one-half in size, and placed on cross timbers, would make the strongest, firmest, and cheapest of ordinary lines of way. Used without sleepers, it would be found the simplest application for army and fortification lines, perfectly manageable by ordinary soldiery, and also for mineral and for agricultural lines where horses are used.

This bridge rail-joint has now been in successful use upwards of six months on one line, and is about to be laid down on four others. The bracket-joints are laying down on four lines.

Models are shown of these brackets, full size, as applicable both to joint and intermediate sleepers. Mechanically this arrangement makes the rails much firmer, as they are lowered two inches on the sleeper; the under sides are not damaged by resting on chairs, so that they are really reversible; there are no keys to get loose, and the weight of metal is considerably reduced as compared with the chair system.

An apology may be due for the prolixity of this detail; but upon the specific questiou of wheels and rails depends the result of profit or loss in railway transit.

And this brings me to a very important consideration of the question at issue. Colonel Cotton compares canals as they are with railways as they are. But there is a manifest distinction. Canals, during the lapse of time from their advent to the present day, appear to have exhausted the fertility of the human mind as to their perfectibility. The only further move is to convert the external haulage of the boats to an internal propulsion. But this needs a size of canal not yet contemplated. But railroads proper have only existed 25 years, and are far from having yet attained their possible perfection. I am not going, after the fashion of Brother Jonathan, "to draw a bill on futurity and cash it at sight;" but I appeal to any competent and unprejudiced observer who is familiar with the items on railways of "maintenance of way and rolling stock," whether reasons have not been pointed out why there is hope for a very material diminution in cost and working expenses. With this proximate and more perfect result, then, must Colonel Cotton compare the water transit he advocates. We are a "practical" people; so practical, that we have changed the very meaning of the word theorem, and made it to signify a fallacy; so that a man must forego the gift of speech, and demonstrate in materials like deaf and dumb people, ere he can gain credence. He must not set up for a critic till he is prepared with something better than the thing he criticises. For this reason only have I loaded the table with models, which seem almost an insult to common sense, as embodying the merest truisms.

There is yet another question. The canal only follows the course of all the earliest settlements, the streams, and leaves untouched the hidden wealth of the yet desert. The railway opens up mineral and other wealth. It will, if rightly used, form a line of new streets and villages. It will bring squatters from all parts to its borders, just as the opening of the Erie canal gathered together what are called "forwarding merchants" from all parts of the Union. Yet another thing. The line of the river is very commonly unhealthy by its locality. The line of the rail will, probably, be much more healthy. The very rushing of the trains sets the stagnant air in motion.

In discussing whether a canal or railway is best, the discussion must, therefore, not wander all over India, like a desultory tribe of broken men, but must be confined logically and specifically to each given river in succession. Let us know the conditions of the river as to its amount of water at all seasons—the gradients of its bed—the obstacles in its course—soil and climate, and we can deal with the question as a calculation, whether it is desirable to make a railway or not in preference to, or in conjunction with, the rivers. All generalising, save as to theory, or laying down principles, is useless, when the question is one of fact, and of specific fact. It is as vague as the celebrated propositiou, "Given the height of the Monument, what is the depth of the Baltic Sea?" or, to put it iuto an American axiom, "It is about as big as a piece of chalk."

Cotton is the staple subject. Let us know in how many localities, and of what extent, cotton grows; and, what is also very much to the purpose, in how many and what sized localities it may be made to grow along the course of the railways *in esse* and *in posse*. Whatever be the amount, there is no doubt that railways can carry it, if not on one line of rails, on two or more; with good gradients, a well-constructed engine, and waggons not damaging to the road, may transport from 100 to 150 tons net at a rate of 15 to 20 miles per hour; and 24 trains a day might follow each other in succession without casualties; in round numbers, a million and a quarter tons per annum. But in such case only one uniform rate of speed could be permitted.

But the real cost of transit on Indian railways cannot be ascertained till a mechanically perfect system shall be adopted, and the fuel procured and manufactured on the spot, and water used in the boilers distilled by the sun, and returned in the form of rain to the Company's tanks, unimpregnated with earthy matters, that destroy the boilers and impede the production of steam. Nor can the railway be properly maintained till provision shall be made for watering the road in dry weather, as well as draining it during rain.

CORRESPONDENCE.

SCREW PROPELLING.

To the Editor of The Artizan.

Sir,—I beg leave to forward you a drawing (Plate liii.) of a novel applicatiou of the screw-propeller, for which I received letters patent on the 6th of this month. It has, I believe, great advantages over the present mode, as I will endeavour to show in this communication.

Hitherto, screw-propellers have been fixed on horizontal shafts, working parallel with the water-line; or when the shaft may not have been perfectly horizontal with the keel, it has been placed out of this position to suit some peculiarity of the vessel. The consequence is, that in the act of driving, when the upper blade of the screw approaches near the water-line, as it does in all vessels of ordinary depth, the water is thrown away from the screw, causing what is called slip, or loss of power.

The attention of engineers and others in most of their improvements has principally been directed to this point; for if this slip could be reduced or done away with, the screw, from its simplicity and economy of space, must entirely supersede the paddle-wheel. The screw itself by these improvements has been made nearly perfect, but nothing yet has been accomplished to reduce materially the great loss of power from slip in shallow waters.

Much experience, in sailing vessels of all kinds, having shown me that the wind exercises its greatest propelling power when applied at an angle, I was led, in examining the question of the screw and its defects, to the conclusion that the same law was applicable to water especially, as in a fish I found the fins and tail invariably act at an angle, and, therefore, that this was the proper mode of applying motive power in connexion with the screw. In following up the question, and investigating the cause and remedy of slip in shallow vessels, I found that when the screw drives in a horizontal position, the water, meeting least resistance at the surface, was thrown away from the propeller and upward, forming a wave abaft the screw; consequently, that the cause of slip was the imperfect density of the fluid, and the impossibility of the screw obtaining a proper grip when opposed to it near the surface in a horizontal line. To meet this defect, I propose giving the screw-shaft an angle downwards; and by doing so, I obtain the following results:—

The water is driven away in a direction in which it meets a denser fluid. It cannot escape without taking a direction upward; but this it cannot do before the screw has left one body of water to act on another. Consequently, as the water cannot leave the screw, it must give the whole power of the engine to the propulsion of the vessel; and, therefore, we obtain what we have been looking for, "a fulcrum without slip."

To make the screw, therefore, nearly perfect, so that it shall supersede all other means of propulsion, we have only to alter the axis or direction of the shaft to the proper angle. This angle, I find, is formed by a line drawn from the centre of propulsion in the boss of the screw up to the centre of gravity or motion of the vessel. It will not be exactly the same in any two vessels—a full, deep ship having a greater angle than a long, sharp vessel, and *vice versâ*; as the points from which the lines were drawn vary with the form of the vessel and the position of the screw. The two screws may also, on this principle, be applied with advantage to the after-body of the vessel.

A remarkable instance of the effect of the screw working on a dense fluid—where the possibility of the escape of the water upward, from the depth at which the screw is formed, is greatly lessened—is found in the trials of H. M. S. *Duke of Wellington* and *Agamemnon*, and the French line-of-battle ship *Napoleon*; which ships exhibited higher results, notwithstanding their great size and displacement, with a smaller proportion of power, as compared with vessels of light draught of water.

Some of the advantages of this application over that now in use are—

1st. The obtaining a more perfect fulcrum, and the consequent saving of power and expense, and also the application of the driving power to the body of the vessel.

2nd. The screw-shaft, rising in board, need not be so long as at present; and the engine and connecting gear may be brought in close proximity with the propeller, giving great economy of space and less liability to accident.

3rd. In consequence of the screw being deeply immersed, and acting on a dense fluid, the vibratory motion must be materially reduced, thereby lessening the wear and tear, and diminishing in proportion the working expenses, and cost for repairing the machinery and vessel.

4th. The screw-shaft inclining upward in board, the liability to leakage through the stuffing-box is reduced; and when the casing is carried up above the water-line, no damage can ensue from this cause.

5th. From the diagonal position of the trunk, less vertical depth is required, and, therefore, a larger screw can be placed in vessels of small draught of water.

6th. In vessels with fine lines, the screw may be placed in the body of the after section, as, from its downward action, little or no obstruction can be caused by the dead-water or wake. This would be a great advantage to sea-going vessels, as frequently, in heavy weather, the screw is now thrown out of the water, shaking the whole stern-frame and materially injuring the engine.

Sailing-vessels can be altered into screws without weakening their stern-frames, as the trunk has an angle corresponding to the dead-wood and stern-post.

To sum up, the advantages of this system are—economy of power, economy of space, less working expenses, and less wear and tear.

Fig. 1 represents the screw fitted on this principle to a deep, heavy ship. The dotted lines show the course of the water with a screw on a horizontal shaft.

Fig. 2 is a long, sharp vessel; and Fig. 3, one of light draught of water.

Fig. 4 is an end view of Fig. 1; and Figs. 5 and 6 are vessels fitted with two screws in the after section.

I am about making a series of experiments with the screw according to my plan, against the screw in the present horizontal position. I hope to have the results ready for you by your next publication.

I am, &c., D. J. Hoare.

R. T. Y. Club, Bedford Hotel, Covent Garden,
August 26th, 1855.

COUPLINGS OF SCREW-PROPELLER SHAFTS.

To the Editor of The Artizan.

Sir,—Practical men engaged in the manufacture, superintendence, or repair of our marine steam-machinery in all its various ramifications, are deeply indebted to you, as also to your numerous correspondents, for the very many useful and practical hints which are to be found in the pages of The Artizan.

Referring to a communication in your last month's Journal, page 194, entitled "Coupling Screw-propeller Shafts," I beg to send you a bit of practical experience (which has been noted amongst my useful facts) in connexion with the same subject, and which, in my humble opinion, is worthy of record in your valuable Journal.

The method of disconnecting the screw-shaft of Her Majesty's steam-frigate *Dauntless*, of 580 horse-power, as originally fitted by Mr. R. Napier, of Glasgow, is shown in the annexed sketch marked No. 1. A is a hollow coupling-box forged on the end of the pinion-shaft of the engine: the hollow part of this box is of such a length that the moveable shaft can be withdrawn about 17 inches. This sketch shows the shaft in its working position: it (the shaft) is kept out by a key or cotter inserted in the key-way, *y y*. To withdraw the shaft or disconnect by this plan, the key or cotter had to be taken out, when the end of the shaft B would be brought home to the inner end of the box A at C.

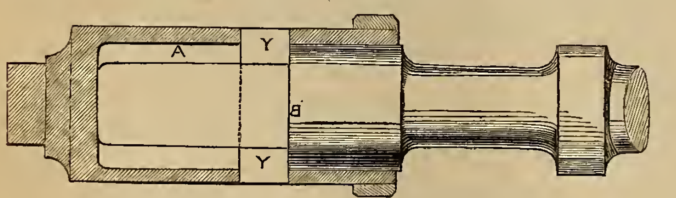


Fig. 1.

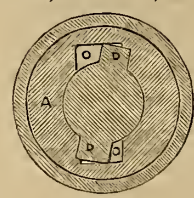


Fig. 2.

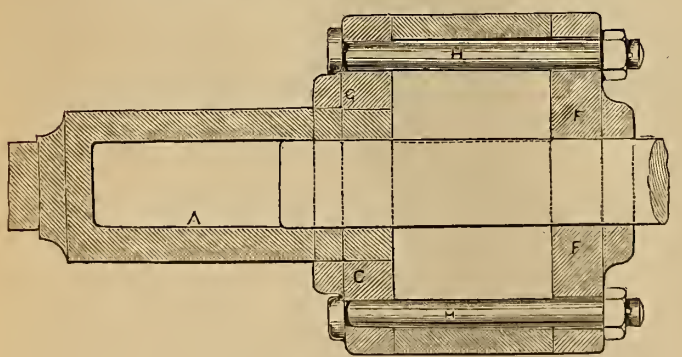


Fig. 3.

No. 2 is an end or cross section of the box A. It will be observed that the power of the engines had to pass *through two small feathers*, marked D, D: the consequence was, that this part of the shafting was a *weak point*, and an endless source of trouble and anxiety to the engineers of the ship. At the end of every journey of a couple of thousand miles, these feathers had gained so much *play* and back-lash, that liners had always to be applied. To such an extent did this *wear* or grinding process go on when liners could not be fitted, that the spaces marked O, O, shown on the sketch No. 2, were the results of a little hard work in the Baltic, in the summer of 1854.

I need not say, that with this play or back-lash it was fearful work, working the engines at slow speed. Many and loud were the imprecations heaped on the whole machinery, especially by the officers whose cabins were in the immediate vicinity of the *coupling-box*, for the horrid noise and disturbance it caused in the ship. However, on our arrival at Portsmouth, in September last year, the thing appeared so bad, that the engineer officers of the Steam Factory condemned it, and substituted the following simple and effective coupling, which does them great credit, of which sketches No. 3 and No. 4 are illustrations.

No. 3 is a longitudinal section in elevation of the Portsmouth coupling. It will be observed that the hollow box A, with the moveable ends of the driving-shaft, are in the same position as in Figs. 1 and 2,—namely, in a working position; the feathers, D, D, being turned off, disc-couplings, F and G, are keyed on with four keys, one on the hollow box A, and the other on the driving-shaft: the space between is the distance the shaft has to be withdrawn; this space is filled up by two skeleton semicircular pieces of cast-iron, made to drop over the six bolts, marked H, which fasten the coupling.

Sketch No. 4 is an end view, showing half in *section* through the distance-pieces.

The *modus operandi* of disconnecting is as follows:—The shafting is *set* to a position where the distance-pieces part horizontally; this can be done at two points of a revolution of the shaft. The nuts of the six large bolts, H, are slackened; the small bolts, K, are taken out; when the lower half will drop, and the top half can be drawn upward by a small block and tackle. The movable shaft will then come home, and the two couplings, F and G, will be brought together. The bolts, H, being fast in the disc, G, and loose in the other, act as guides to the moveable shaft.

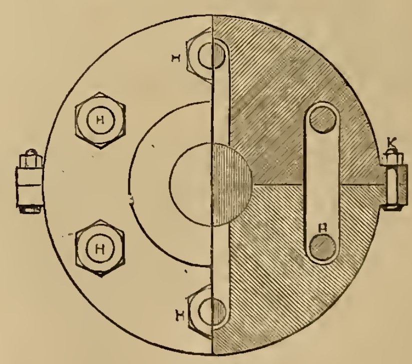


Fig. 4.

As the method of withdrawing screw-shafts is now abandoned in all new constructions in the Royal Navy, this can be of no use for such a purpose. Still, however, this really efficient and simple coupling, tested to 580 horse-power, may be of service in circumstances similar to the *Dauntless*, or where it is necessary to have a withdrawing shaft.

Since the vessel left England, she has had a good share of hard work at the seat of war in the Black Sea, and the coupling has answered admirably. I am, your obedient servant,

An Engineer, R.N. (ex the *Dauntless.*)

Woolwich, 28th August, 1855.

MARINE BOILERS.

To the Editor of The Artizan.

Sir,—As an old subscriber to your valuable Journal, allow me the liberty of asking you why the engraving of the boilers of the *Metropolis* U.S. steamer has been omitted in the account given of the vessel in your number for August, under the head of "American Notes, No. 8." I would also draw your attention to a few facts relating to the boilers of that vessel. It is quite apparent that our scientific friends on the other side of the water find less difficulty in obtaining patents than foreigners. The latter are refused an American patent, frequently, on the ground of previous publication in an English periodical, though it may have appeared only as a vague suggestion, and never been practically applied. In the American Notes above alluded to, it will be seen that Mr. D. B. Martin, Engineer-in-Chief of the U.S. Navy, has had a patent granted to him for a boiler "which was considered sufficiently novel by the Patent Office to justify a patent being granted to him." This invention has not only been patented in England by the Earl of Dundonald, and

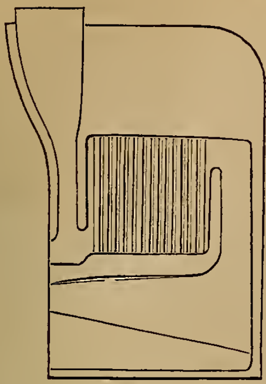


Fig. 1.

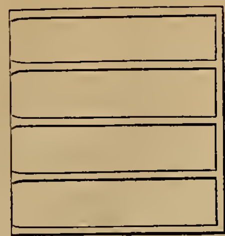


Fig. 2.

used for some years both for sea and land purposes, but was also published in England in the year 1846, and reprinted in 1851, a copy of which work I beg to forward to you, and you are at liberty to use the two engravings as under. About four years ago, a similar attempt to the present was made to deprive the gallant Admiral of the merit of the invention, in a paper descriptive of the boilers of the Collins line of packets, on which occasion this pamphlet was copied entire into the "Mechanic's Magazine." Again, in your Journal for January, 1854, page 13, you generously advocated his Lordship's claim, in your criticism on a published work by C. B. Stuart, wherein the boilers of Collins' line are referred to. I must, however, remark that, like the Collins line boilers, those of the *Metropolis* are a very indifferent copy of the originals; in consequence of which, much of their efficiency has been sacrificed, as will be obvious on a simple inspection of the drawing. These vertical-tube boilers have produced a degree of economy in the consumption of fuel which no other construction has attained.

I am, Sir, yours most obediently,

August 17th, 1855. AMHERST H. RENTON.

[The Plate of the boilers of the *Metropolis* could not be prepared in time for our last number, but is given with this month's ARTIZAN. The woodcuts of Lord Dundonald's boilers, given above, will enable our readers to judge for themselves as to the similarity of the two boilers.—ED.]

THE STATE OF THE THAMES—LONDON SEWAGE.

To the Editor of The Artizan.

SIR,—As the state of the sewerage of the metropolis is now necessarily calling for some decisive measures, I beg to inform you that I lately submitted a mode of dealing with it, both to the Metropolitan Commissioners and to the Lord Mayor, having for its object the daily cleansing of the sewers by flushing, and, of course, the prevention of accumulations, which will naturally reproduce the mischiefs now complained of, and which will eventually usher in some dreadful epidemic.

My suggestion is, to make the experiment by sinking a shaft in the neighbourhood of the Charter House to the level of the Thames, to be connected therewith by a tunnel; to erect a powerful engine at this shaft to raise the water into the streets and sewers, which torrent of water can be directed from point to point, and to sweep the sewers successively.

By feeding the boilers of this engine with air from the sewers, the atmosphere will *enter* the gratings, and carry off the gases by means of the engine chimney; which ventilation would render the sewers accessible and healthy.

Lastly, by working the engine immediately after high water, the nuisances would pass downwards with the ebb tide, and gradually work to sea.

The advantage of a reservoir at said engine would afford a supply of water for the people, and a ready supply in cases of fire; whilst the cheapness and facility with which the experiment can be tried cannot be gainsaid.

And after the grand intercepting sewers are completed—*if ever that day arrives, which I much dispute*—will not this system be a useful—nay, necessary appendage? For we have never yet learnt from what source the gigantic sewers are to be supplied with such a mass of water as will liquefy and float away the filth of the metropolis at a fall of 4 or 5 feet to the mile, and in a sewer of 10 or 12 feet in width.

MATTHIAS DUNN, Government Inspector of Mines.

Newcastle-on-Tyne, 22nd August, 1855.

P.S. The above would apply to a certain district; and if found effective, other districts might be provided for in a similar manner.

REGULATOR FOR MILL GOVERNORS.

To the Editor of The Artizan.

SIR,—I send you herewith sketches of an apparatus which I designed in June, 1851, as a regulator to a 25 horse-power high-pressure engine. I think some of your readers may find it useful under similar circumstances.

In February, 1851, I made a contract with Mr. Tschurbakoff, of St. Petersburgh, to act as superintendent of machinery of his cotton printing establishment at Chakooshey, better known as "Mr. Lutche's Fabrik."

He had two steam-engines erected upon his works: one of them was built in France—the other by Messrs. Mather, of Salford. These engines were to drive heavy calenders, starching machines, and bleaching and drying machinery. The latter machines were also supplied by Mather. When the machinery had been worked some time, a greater demand arose for beetled or watered goods than was anticipated; and not having sufficient time to get a machine for the purpose from England, I was compelled to make one on the premises. When this machine was finished and set to work, I found that the speed of the engine became very irregular, owing to the workmen throwing two and sometimes three machines out of gear at once: on that account, and notwithstanding that we had a very nicely-constructed governor attached to the Mather engine, the engineer was obliged to stand by the shut-off valve to check or admit the steam. Now, this was a troublesome and expensive matter, and the contrivance which I now proceed to describe was schemed by me to obviate these disadvantages: it answered entirely to my satisfaction. It was applied in June, 1851, and continued to be used up to the time I left the establishment, in February, 1853; but I have not been upon the premises since that time, and do not know if it is still in use, but believe it is. I have explained the apparatus to a great many Englishmen in St. Petersburgh, engineers and other mechanics, as I make no secret of it; and after my return to England, in February this year, I explained it to Mr. Bertram, of Woolwich Dockyard, who thought highly of it, and advised me to make it known.

Recently, in conversation with Mr. A. Tischbein, who is a celebrated engineer at Rostock in Germany, I explained it to him, and gave him a sketch of the apparatus, about four months since; but, to my astonishment, a few days ago, one of his draughtsmen called my attention to a description of *Jones's Patent* for a similar contrivance, described in your valuable work of reference, in the Number of September, 1853—that is, two years and two months after mine had been in practical operation. There is a difference in the construction, which will be seen on reference to the respective drawings and descriptions.

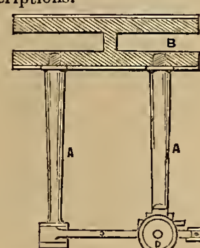


Fig. 1.

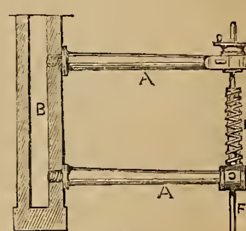


Fig. 2.

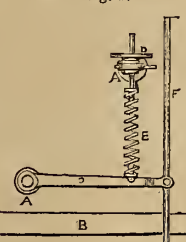


Fig. 3.

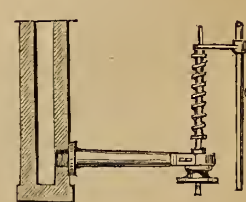


Fig. 4.

The following is an explanation to the enclosed sketches:—

Figs. 1, 2, and 3 represent the plan, side view, and front view; A, A, A, A, A, A, columns, screwed into entablatures, B, B, B. I have to state that entablatures shown here are not drawn to any scale, but merely to show how the apparatus was fixed.

The apparatus is drawn quarter-size, or three inches to a foot, as near as I can remember.

c c c represent a lever which I was compelled to introduce, on account of the throttle-valve rod being so long that it frequently formed itself into a curve if the packing was not perfectly slack.

d d d, brass regulating nut, which was made to compress or extend the spring, according to the load on the engine, which will be very necessary for some engines where the throttle-valve rod cannot be lengthened.

e e e, a spiral spring, which was fastened at each end, as shown, the ends being let into the collars, which formed a dovetail, which kept it quite secure: diameter of spring, 5-8 in., about 5 in. long, made of 1-16 in. steel wire. I cannot see what benefit Mr. Jones derives in having two springs.

f f f, rod which connects the governor lever with throttle-valve. It was made in two pieces; one part with a left, and the other part with a right hand screw, with a long nut; also with a right and left hand screw, on account of the bottom lever, where the rod had to be connected (which was a counter-lever), having holes in it about $1\frac{1}{2}$ in. or 2 in. apart, so that we could shift the throttle-valve rod if required.

Fig. 4 represents the plan I should have made it on, had not the rod been so long; by that means I should be able to get a guide-rod through the spring; which rod has a guide through the arm or lever, extending from the throttle-valve rod, *g*.

I may also add, that I introduced a novel metallic stuffing-box to the French engine about the same time, which answered extremely well up to the time of my leaving. The Russian Government had received a plan of it from me, and I will forward you a sketch as soon as convenient.

August 17th, 1855. THOS. MERITON.

FLOATING BATTERIES.

To the Editor of The Artizan.

Sir,—Knowing that during the wars at the early part of this century, the whole time of the Naval authorities was consumed in the business of the day, and supposing that it must be so at present—seeing also that there is no longer any officer to whom proposals for improvement can be referred—I hope that the following suggestions may be deemed worthy of insertion in your Journal.

It appears that many small vessels taken from the enemy are sent to this country, whilst lesser craft are destroyed: might it not be advisable to arm such vessels and use them against the foe? Our magnificent three-deckers being unfit for warfare in shallow waters, their place might be efficiently supplied by craft of small draught, if heavily armed, as experience has shown to be practicable. I allude to a flotilla which, nearly seventy years ago, was eminently successful in the Sea of Otchakoff, to Sir Sydney Smith's defence of the town-gates of Acre, and to our late success in the Sea of Azoff, due to small vessels only, amongst which the raft the *Lady Nancy* did essential service.

For the Sea of Otchakoff, large ordnance was mounted on small vessels by Sir Samuel Bentham as follows:—Six barges, 77 feet long, 22 feet 6 inches broad, and 5 feet 4 inches deep, their decks being strengthened by pillars, also cleared for recoil by removing the hatchways to the sides, were armed each with eight long 36-pounders, the four on either side placed, not opposite to the four on the other, but to the middle of the intermediate spaces. Two other barges received each six 18-pounders, three on either side, and between them a 13-inch non-recoil mortar; also, two 36-pounders fitted as bow-chases, and attached to a breeching passed over a shieve, so that the recoil of one drew out the other; whereby loading was effected within board, and no time lost in replacing them at the port. Ship's long boats had one large howitzer or mortar *fixed without recoil*, and mounted without any distinct carriage, by bedding its trunnions in two fore and aft bulkheads. The firing was either point-blank or at small elevations. The flotilla so fitted, not only discomfited one much more numerous, but attacked twelve protecting ships of the line, of which it took, burnt, or sunk no less than nine. This extraordinary achievement was in a great measure attributable to the shallowness of the craft composing the victorious flotilla, enabling it to choose its situation so as to avoid the enemy's missiles, whilst its own large ones, particularly its shot filled with combustibles, did wonderful execution.*

Sir Sydney Smith defended the town-gates of Acre by a floating battery of three old barks lashed together, and armed with two 68-pounder carronades, and three other large pieces of artillery. Old and crazy as were these barks, they at the end of 60 days' fire were still in a serviceable state, having only become "a little leaky."†

Supposing a flotilla of small vessels fitted out, how could it be manned? Good seamen being scarce, part of the usual complement for working a gun might be saved, by adopting, to a limited extent, the principle of non-recoil. The only plausible objection to this mode, that the crew in loading are exposed to the enemy's fire from small arms, was disproved in the many actions in which were engaged six experimental vessels of 1795: their remarkable escape from casualties was attributed to the rapidity with which non-recoil guns are fired; as, for example, the *Millbrook* discharged a *seventh* broadside by the time her opponent, the *Bellone*, had fired a *second*. The victorious little schooner lost not a single man, though scores of the enemy were killed.‡

In the conversion of small vessels to warlike purposes, it may be concluded that guns would not be placed under the deck, but upon it, as must have been the armament of the *Lady Nancy*, she being a mere raft. All honour to her contriver, Commander Coles, and to his brave seamen, who constructed her in a single night! It is evident that whether ordnance be fitted to recoil or not, in loading upon an open deck, the men must be equally exposed to the enemy's fire; and, consequently, it is only in regard to decked ships that the expediency of non-recoil can be questioned. That great authority, Sir Howard Douglas, in the last edition of his "Naval Gunnery," does, it is true, say that the belief of seamen that guns will carry farthest when lashed is a mistaken notion; but it must be observed that his further statements go to prove that at sea the motion of the ship may render recoil mischievous. Sir Samuel pointed out, on this score, that a non-recoil gun could be fired in all weathers, whatever might be the inclination of the deck: and it should not be forgotten that a non-recoil carriage costs full half less than a recoil one—that the gun can be fired twice as fast if not allowed to recoil, and by half the usual number of men.

I am, Sir, &c.,

13th August, 1855. M. S. Bentham.

SALARIES AND PENSIONS.

To the Editor of The Artizan.

Sir,—Most true it is, that neither the pay nor the pensions of operative officers in royal dockyards are sufficient; but where does the blame rest? Surely not upon the Admiralty; but it does upon public opinion, and upon the expression of it in the House of Commons. The first attempt at reform should, therefore, be to impress the public with a conviction that it is their own interest which should engage them to pay better, and to pension better, their operative officers; for till this be effected, it were vain to attempt any change of system in the authorities, since they *dare not* militate against the public voice. It is, however, certain that lesser emolument will engage a man in Government employ than he could obtain in a private concern; for (save misconduct) Government employ is sure, whilst that of private trade is open to many risks. Without losing sight of this truth, still it is the true interest of Government to remunerate their operative servants more liberally than at present is done in the dockyards. The consequence of inadequate pay and pensions is, that very superior talents and industry usually cause men to seek their reward in private establishments: hence, doubtless, arises the alleged inferiority of dockyard skill to that evinced in private concerns.

Another, but frequently *concealed*, mischief arises to the public service from the inadequacy of pay and pension: it is, that pay and pension are often eked out by underhand profits, or at least such as are connived at by superiors. Half a century ago, many such were brought to Admiralty notice by the late Brigadier-General Sir Samuel Bentham, and, in consequence, direct profits of all descriptions were done away with. Sir Samuel flattered himself that adequate compensation would be accorded by a commensurate increase of salary; yet, notwithstanding his utmost endeavours, the Admiralty *could not* increase them proportionally, because *public opinion* would not allow it. During Earl St. Vincent's naval administration, the accustomed perquisites were abolished, his Lordship proposing to increase the salaries to dockyard officers; but a change of administration taking place, this augmentation was not accomplished, though, to my knowledge, a master shipwright's assistant at Portsmouth was a loser to the amount of a couple of hundred pounds yearly by the non-receipt of presents, such as wines and grocery, all of them customary donations without expectation of service in return. I believe that similar gifts are no longer received; but surely dockyard officers must still have some means of augmenting their scanty salaries: indeed, I chance to know that in some instances the Admiralty have authorised private employment, which, of course, would be amply remunerated by the private employers.

The Artizan brings forward the comparative expense of a scientific education with that necessary for clerk-like duties. The clerk, if he can read and write, and cast accounts, is competent for his situation; but the operative officer, to be efficient, must have acquired a perfect knowledge of his particular trade, and, in addition to it, the management of *men*—a task far more difficult than that of the due employment of inanimate materials: yet The Artizan has shown that the clerk is better paid than the officer in an operative branch of business. Better regulations in this respect come within the province of the Admiralty, and it may be hoped that their Lordships will institute some more favourable pay for their operative officers.

There can exist no reason whatever for limiting the pensions of officers to the period during which they have received remuneration by a *yearly* salary, excluding all such time as they may have been on *day*-pay. This, too, is a regulation injurious to the public: it tends to the accordance of salaries, in many instances, where day-pay would be more desirable, as facilitating the dismissal of an officer without degrading him. For this reason, the masters of three new manufactories in Portsmouth Dockyard had weekly pay, not salaries. There never, indeed, seemed any reason to get rid of them during the seven years they were under Sir Samuel Bentham's management; but it would have been unjust to those officers, had they had to forego pensions because they were on day-pay. But pensions are in a manner abitrary, depending on the will and pleasure of the authorities; as, for instance, those of superannuation to shipwrights. Every year it is seen, by the list of superannuations, that they have not been accorded in conformity to any fixed rule; whereas superannuations should be *certain*, in order that they may be reckoned as a part of pay. Sir Samuel accordingly urged, that after a certain number of years' service, and according to the length of it, every individual in a dockyard should be assured that in old age he would receive enough to exist upon. The then Comptroller of the Navy objected to this, and the General gave his reasons in favour of the measure in his official "Answer to the Comptroller's Objections." These arguments have not hitherto succeeded, and what is the consequence?—that aged operatives past labour are still kept on the dockyard books, and are paid at the same rate with the young and strong. Good policy would require that both officers and working hands should, in their days of health and strength, be assured that Government would provide them with a competency on the failure of their powers; whilst, on the other hand, the public would be no loser, for the assurance of a competency in old age would be reckoned as a part of, and, consequently, diminution of, present salary or wages.

Towards the end of the last century, some near-sighted economist in the House of Commons proposed and carried a tax of seven and a half per cent. on all places and pensions. The hardships of this measure have been little commented on, though open to weighty objections. Had the Legislature conceived that the employed were overpaid, the simplest remedy would have been a general reduction of pay and pensions to any amount desired; but such an enactment should have been direct and general, and under its proper name. As the tax is now imposed, it gives rise to many evils: the placeman or the pensioner is apt himself to count upon the receipt of his whole pay or pension, and, at all events, his neighbours, if not his family, measure the reasonableness of his disbursements according to the *nominal* amount of his receipts, not to his actual ones: "He has," say they, "so many pounds sterling a year: how shabby it is of him to deny himself and children so and so!" This, however, is but a small evil compared to that which the tax gives rise to—I mean the *uncertainty* of the application of the tax; for, in many instances, it has not been levied. This, of course, enables heads of departments to favour individuals by exempting them from the duty. I know that it has been so in regard to *all* the officers in one department, and understand that in other cases it is frequently the same; nay, what is, if possible, worse—in some instances it has at one time been remitted, at other times not so. Surely, on every account, heads of departments ought not to be entrusted with such a concealed and arbitrary power of favouring individuals.

I am, Sir, &c.,

M. S. Bentham.

* For a further account of these actions, see the "United Service Journal" for 1829, part 2, page 333.

† Naval Papers, by Sir Samuel Bentham, No. 7, page 32. ‡ Ibid. page 20.

NOTES AND NOVELTIES.

The recent Operations in the Baltic.—The success which has attended the attack of the Allied Fleets in the Baltic—the destruction of the strong Russian fortress of Sweaborg, on the 12th day of August—induces us to believe that the following description of Sweaborg and other Russian fortresses in the Baltic will be interesting to our readers:—

"The fortress of Sweaborg is the most formidabable obstacle in the Gulf of Finland, and does the outpost duty, as it were, for the great military *entrepôts* of St. Petersburg. On the east this fortress also partially commands the most navigable channel for vessels of a large draught of water, on the voyage to Cronstadt, which is distant 163 miles, on the St. Petersburg side.

"Sweaborg is composed of seven rocky islands, and is situated about three miles and a half from Helsingfors. It fell into the possession of Russia with the Grand Duchy of Finland; but, unlike Helsingfors, which was first regularly fortified by the late Emperors Alexander and Nicholas, Sweaborg had been a place of considerable strength under the Swedes. General Ehrenfwald, an able Swedish officer, considering that these islands might be rendered a formidable stronghold, and might enable Sweden to maintain her power in the Baltic, in spite of the ambitious designs of Russia, projected the plan of their fortification. Previously, however, ships were built and repaired there for the Swedish navy. The works were commenced in 1748, but were not completely finished when acquired by the Russians, who have continued making improvements, and devising every means of rendering the place impregnable. They say, 'the Swedes began, but we finished the Gibraltar of the North.' These works are stupendous. The walls are chiefly hewn granite, covered with earth, rising in some places to a height of 48 feet. The batteries, which commence on a level with the water, and rise in tiers one above another, are mounted, it is said, with nearly a thousand guns. In Wolf's Island, the principal of the group, there is a dry dock, capable of containing eleven or twelve frigates, which has been completely hollowed out of solid rock, the length being 300 feet, breadth 200, and depth 14 feet. At one extremity of this dock is a basin 200 feet square, closed at each end with sluice-gates, which serves for the entrance and exit of frigates, and for repairing and building ships. The stores and ammunition for the batteries are deposited in magazines, on the edge of the water. The harbour can contain seven ships of the line and a few frigates.

"The three fortresses—Cronstadt, Sweaborg, and Helsingfors—could not have been intended for the defence alone of St. Petersburg. They tell their own tale. The magnitude of their works, and the incessant activity in the arsenals during the last half-century, should have clearly warned Europe that these huge fortresses were intended as a basis of operations against its liberties and the rights of its rulers.

"Cronstadt, which commands the passages at the mouth of the Neva, was taken from the Swedes by Peter the Great, and first converted by him from a desert island into a harbour for his navy in 1710. The most invulnerable portion of the stronghold, a rampart of granite built in the sea for the protection of the shipping, was begun and finished under the superintendence of Admiral Greig, who is styled the father of the Russian navy. Doubts are entertained whether the guns of Cronstadt completely command the northern passage: the Marquis de Custine, a keen inquirer, declares that although he put himself to some trouble to learn as much, he could not find the Russian who would inform him of the fact.

"The population of Cronstadt is about 45,000; of Helsingfors, which is the capital of the district, 10,000; and of Sweaborg, about 4,000; the greater part of whom are tradesmen and merchants, who depend on supplying the garrison and fleet, and who, as if the Russians anticipated on this occasion a serious attack from the Allies, have been removing to Helsingfors during the last few weeks."

The Vienna correspondent of the *Manchester Guardian* says—"I have been informed to-day, from a source from which good information is generally to be gathered, that the projected canal from Rassova to Kustendje presents such great engineering difficulties, on account of the great scarcity of water in the district through which it is to pass, that it is by no means unlikely that the idea will be abandoned, and a railway substituted in its stead."

Acts of Parliament passed in the late Session.—The number of public Acts passed in the late session was 134, and of local Acts 198.

NOTICES TO CORRESPONDENTS.

J. H., R. A., C. Walker, and other Subscribers.—Our arrears of matter being still large, although we have done our best to clear them off—and notwithstanding the extra sheet which we recently gave, and the numerous additional Plates we have recently published—we find ourselves unable this month to fullfil our promises, made in the July and August numbers, to clear up the arrears of original matter, correspondence, &c.

The second Plate illustrating the South Inlet Dock at Portsmouth will be given next month.

Quartz Crusher.—The grinding and levigating apparatus patented by Mr. Goodall, of Derby, and described by us, August, 1854, was not intended for crushing quartz; nor is its action, even if it were made on a suitably large scale, at all adapted for the purpose respecting which you inquire. As far as our experience extends, and in accordance with which we have erected quartz mining machinery in California, the Cornish stampers and Chilian mill have given the best results, compared with the cost of erection and working. The Berdan machines, we are informed, have proved to be commercially unsuccessful.

M. D., A. H. S., W. E. G., A. O. D., &c.—We shall be glad to receive your promised communications.

DIMENSIONS OF NEW STEAMERS OR SAILING VESSELS.

SCREW STEAM-FRIGATE "VICTORIA."

Built by Young, Son, and Magnay; Engines (of 150 nominal horse-power) by George Rennie & Sons.

Dimensions.	ft.	tenths.
Length on deck	166	5
Breadth of beam, extreme ...	27	16
Depth of hold	14	5
Length of engine-space, exclusive of shaft-alley	48	75
	Tons.	
Engine-room	200	
Register, N. M.	$448\frac{1248}{3500}$	
Ditto, O. M....	$580\frac{83}{94}$	

Kind of engines, patent direct-action; do. boilers, tubular; diameter of cylinders, $38\frac{1}{2}$ inches; length of stroke, 1 foot 10 inches; diameter of paddle-wheel over boards, 10 feet; length of boards, 2 feet 10 inches; depth of do., 15 to 16 feet; number of do., 2. Number of boilers, 2; length of do., 13 feet 6 inches; breadth of do., 7 feet 6 inches; height of do., exclusive of steam-chests, 11 feet; cubic feet in steam-chests, 680. Number of furnaces, 8; internal diameter of do., $2\frac{1}{2}$ feet; area of immersed midship section at load-draft, $292\frac{5}{10}$ feet; load on safety-valve in lbs. per square inch, 20.

The *Victoria* is timber-built, on the system perfected by Mr. O. W. Lang, of H. M. Dockyard, Pembroke, and from a design by that gentleman, consisting of two thicknesses of board, wrought diagonally from gunwale to gunwale across the middle line at right angles to one another, with an external planking, wrought as usual, having inside floors and best planks, wrought vertically at intervals from the middle line to the gunwale, with shelf-pieces, clamps, beams, hooks, crutches, decks, &c., as usual, the whole being thoroughly fastened with *copper* bolts and nails.

The *Victoria* is now fitting out for a screw. She is built wholly at the expense and for the service of the Local Government of the Colony of Victoria.

The following are the dimensions of the screw-steamers

"PROPELLER" AND "POWERFUL."

Dimensions.	ft.	inches.
Length between perpendiculars ...	192	0
Breadth of beam	28	6
Depth	17	0

Propelled by a pair of inverted direct-acting engines of 120 horse-power collectively; diameter of cylinder, 42 inches; stroke, 2 feet 9 inches; with tubular boilers, having 20 feet heating surface per nominal horse-power. Both vessels have been remarkably successful in their performance, having realised great speed, carrying large cargoes. The engines make 52 revolutions per minute, and drive a three-bladed propeller, 12 feet 6 inches in diameter, and 25 feet pitch, the consumption of coal being 14 cwt. per hour. Vessel, with 700 tons of cargo on board, steams 11 to $11\frac{1}{2}$ knots per hour. They are also magnificently fitted for passengers, having a full poop for saloon, deck-house amidships for officers, and full forecastle for forecabin passengers and crew. They are fitted with Beattie's patent method of applying the propeller outside the rudder. The following extract from one of the daily papers gives a very favourable account of the power of these vessels:—"The Hull and Hamburg *paddle-wheel* steam-ship *Helen McGregor* has, up to this season, been deservedly considered the fastest steamer between the Umber and the Elbe; but a new star has arisen in the same hemisphere, which bids fair to eclipse the favourite."

The North of Europe Steam Navigation Company's new iron screw-steamer the *Powerful*, running between Grimsby and Hamburg, arrived at Grimsby on Monday last, at 7 p.m., with a heavy cargo of grain, in $38\frac{1}{2}$ hours from Hamburg. This ship left Hamburg on Sunday, at 4·30 a.m., an hour and a half after the *Helen*, and at noon, when at the Elbe-light ship, was about 15 miles astern of her; at 7 p.m. she was up with her, and was out of sight ahead long before noon next day. The *Helen* arrived at her destination at 10·30 p.m., $3\frac{1}{2}$ hours after her rival the *Powerful*. Although the *Powerful* had to contend with strong E.N.E. winds and heavy head-sea on her outward voyage, she maintained a speed of 10 knots throughout the voyage, under steam alone. She has already proved herself to be a first-rate sea-boat in bad weather: her passengers speak highly of their comfortable quarters on board, her owners having spared no expense to render her a first-rate steam-packet, replete with every comfort. The *Propeller* steamed from Balaklava to Constantinople in 28 hours, being less time than done by the *Banshee*. They are iron ships, built and fitted by Mr. Thomas D. Marshall, of South Shields, and were designed by Mr. John Dudgeon, of Fenchurch Street, London, to carry out the ideas of Capt. W. S. Andrews, Managing Director of the North of Europe Steam Navigation Company, and who is entirely satisfied with the results obtained. The vessels carry large cargoes, 60 first-class passengers, and the total absence of vibration renders them most comfortable vessels. They are another step ahead in the way of screw-steaming.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 31st March, 1855.

723. W. H. Balmain, St. Helen's — Recovering oxide of manganese from chlorine.

Dated 25th April, 1855.

922. A. Crosskill, Beverley — Machinery for cutting and reaping.

Dated 4th May, 1855.

997. J. P. de Frontin, Agen, France—New material for paper.

Dated 26th May, 1855.

1198. J. C. Ricu and C. Bartocci, Fuligno—Beverage.

Dated 4th June, 1855.

1270. H. J. Kaye, 71, Denbigh-street, Belgrave-road, and P. Burrell, Hermitage, Camberwell-grove — Communicating to two trains in motion the distance they are from each other.
1274. G. Green, Mile-end-road—Sawing machinery.

Dated 22nd June, 1855.

1433. S. E. G. Simon, Paris—New material for paper.

Dated 28th June, 1855.

1474. Captain C. J. Symons, B. A., Hereford — Steam-engines.

Dated 3rd July, 1855.

1498. W. Hammant, 1, Stanfield-street, Stepney — Condensing smoke.
1499. R. Muckelt, Salford—Etching machinery.

Dated 4th July, 1855.

1500. G. Guillaume, 81, Marland-place, Southampton—Communicating power.
1501. G. A. Tabourin, Lyons—Metallic arch.
1502. R. Tidmarsh, 23, Foxley-road, Camberwell New-road —Lubricating metallic and other surfaces when in motion.
1503. W. Clay, Liverpool—Manufacturing forged iron.
1504. C. Hide, Worthing—Connecting earthenware pipes.
1505. J. Inglis and A. Cowie, Glasgow—Moulding metals.

Dated 5th July, 1855.

1506. S. G. Flagg, Philadelphia—Folding boat. (A communication.)
1507. J. Connor, Coventry—Communicating betwen drivers and guards of railway trains.
1508. W. Gerhardi, Manchester—Safety-valves.
1509. S. Oddy, Adelphi Iron-works, Salford — Bearings of mule-spindles.
1510. J. and T. Horton, Birmingham—Paper, pasteboard, and pulp.
1511. J. Howard, Bedford—Ploughs.
1512. T. Felton, Birmingham—Glass reflectors.
1513. R. A. Brooman, 166, Fleet-street—Figured net and other fabrics. (A communication.)

Dated 6th July, 1855.

1514. J. V. Asbury, Enfield—Neutralising collision of railway trains.
1515. J. Bullough, Accrington; R. William, Blackburn; and J. Walmsley, Accrington—Warping by power.
1516. J. A. Bellay, Paris—Earthenware and china articles.
1517. W. Balk, Ipswich—Portable steam-engines.
1518. A. H. A. Durant, Tong Castle, Salop — Extracting castor-oil.
1519. W. R. and W. Morris, Deptford, and R. Chrimes and G. Eskholme, Rotherham — Preventing waste of water from service-pipes or cisterns.
1520. J. Beckett and W. Seed, Preston—Spinning machinery.
1521. W. Boyes, Preston—Looms.

Dated 7th July, 1855.

1522. J. Gedge, 4, Wellington-street south, Strand—Aërated waters. (A communication.)
1524. E. V. Neale, 4, Russell-place, Fitzroy-square—Vitreous substances for labels, tablets, finger-plates, tiles, &c.
1525. J. Pym, Stanley-street, Pimlico—Materials for building purposes.
1526. F. Yates, Birmingham—Dinner and dessert fork.
1527. C. F. Werner and L. Piglhein, Hamburgh — Elastic stuffing for chairs.
1528. A. White, Glasgow—Grinding grain.
1529. E. W. Burrows, Clerkenwell—Increasing efficiency of steam-engine and other power.

Dated 9th July, 1855.

1530. R. Roberts and G. Coppock, Heaton Norris—Looms.
1531. H. E. Flynn, Ranelagh, Dublin—Preventing fire from overheating of flues.
1532. J. Prophet, Broughty Ferry—Confectionery.
1533. J. Tetlow, Oldham—Spinning machinery.
1534. H. Crossley, Grove, Camberwell—Projectiles.
1535. A. V. Newton, 66, Chancery-lane—Fire and burglar-proof glass. (A communication.)
1536. J. and A. B. Seithen, Regent's-square—Cork-cutting machinery.

Dated 10th July, 1855.

1538. G. Riley, 12, Portland-place north, Clapham-road — Mills.
1539. J. Palmer, Oldham—Carding machinery.
1540. E. Kopp, Accrington—Mordants.
1541. R. A. Brooman, 166, Fleet-street — Securing wheels upon axles. (A communication.)
1542. H. E. Flynn, Retreat, Ranelagh, Dublin—Preventing evil effects of recoil of cannon.
1543. C. J. C. Elkington, Hall-street, City-road—Depositing alloys of metals.

Dated 11th July, 1855.

1544. H. Pratt, Worcester—Mills. (Partly a communication.)
1545. J. H. Johnson, 47, Lincoln's-inn-fields—Facilitating performance of music on organs, pianos, &c. (A communication.)
1546. J. H. Johnson, 47, Lincoln's-inn-fields — Permanent way of railways. (A communication.)
1547. J. H. Nalder, Alvescott, Oxford—Dressing grain.
1548. J. Wilson, Manningham, near Bradford—Rolling or piece boards.
1549. E. Hart, Nottingham—Lace.
1550. J. Coulson, Penzance—Ventilating mines.
1551. J. Jeffreys, Kingston-hill—Sun-blinds.
1553. J. Jeffreys, Kingston-hill—Steam-boilers.
1554. J. Adams, Aldwincle, Northampton—Time indicator.
1555. C. F. Bielefeld, Wellington-street, Strand—Saddle-trees.
1556. W. Williams, Bedford—Bricks, pipes, and tiles.

Dated 12th July, 1855.

1557. B. Greening, Manchester — Washing and mangling machinery.
1558. J. Robinson and W. Wedding, Manchester—Machinery for cutting paper, &c.
1559. J. Bethell, 8, Parliament-street—Preserving provisions.
1560. F. H. Edwards, Newcastle-upon-Tyne — Motive power.
1561. E. D. Chattaway, Edinburgh — Railway buffing and coupling apparatus.
1562. J. Caldow and J. B. A. M'Kennel, Dumfries—Cutting vegetable substances.
1563. E. Simons, Birmingham—Condensing smoke of, and increasing illumination from, gas flames.
1564. J. H. Weston, Cross-street, Newington Butts, and J. E. Lewis, Nicholas-street, New North-road—Moderator lamps.
1565. R. D. Obissier, Bordeaux—Motive power.

Dated 13th July, 1855.

1566. J. H. Tuck, Pall-mall — Condensing or exhausting atmospheric air. (A communication.)
1568. T. Redmayne, Rotherham—Stove-grates.
1569. J. Higgin, Manchester—Clearing and brightening dyed and printed fabrics.
1570. S. C. Lister, Bradford—Weaving.
1571. G. T. Bousfield, Sussex-place, Brixton — Boots and shoes. (A communication.)
1572. R. Cochran, Glasgow—Preparation of clay for potters' use.
1573. R. Hornsby, Grantham—Thrashing machines.
1574. E. Gillett, Bruxelles—Fixing artificial teeth.
1575. M. Lawton and T. Schofield, Micklehurst—Spinning machinery.
1576. R. A. Brooman, 166, Fleet-street—Pumps. (A communication.)
1577. R. Yeates, Trafalgar-place west, Hackney-road—Lock and lever knives.
1578. L. Koch, New York—Making pulp from wood, &c.
1579. R. Burns, Liverpool—Teethed gear.
1580. H. Grafton, Rolles-buildings, Fetter-lane — Fire-lighters.
1581. P. J. A. Gaudin, Skinner-street, Snow-hill—Baths for photographic purposes.
1582. C. L. Neale, 1, Chapel-place, Cavendish-square — Neuralgic specific.
1583. L. C. J. Poliesse, jun., and C. A. J. Lengelée, Ham, France—Encaustic matters.

Dated 14th July, 1855.

1584. J. J. Derrieij, Paris—Lozenges, wafers, pastiles, &c.
1585. F. Hamilton, Bolton-le-Moors—Carding engines.
1586. T. Sadleir, Mulla, Tullamore—Heating liquids.
1587. F. Burke, Montserrat, West Indies—Preparing fibres of plantain, banana, aloe, &c.
1588. E. S. Atkinson, Knottingley — Condensing muriatic acid gas arising in the manufacture of sulphate of soda.
1589. J. F. Kealey, Oxford-street—Pulping vegetable substances.

Dated 16th July, 1855.

1590. W. H. Tayler, 19, South-row, St. Pancras—Screw-cap and fittings. (A communication.)
1591. A. Reggazzoli, Milan—Impelling railway carriages up ascents. (A communication.)
1592. L. Gavioli, Modena—Musical instrument, called clavi-accord.
1593. J. B. Pascal, Lyons—Motive power.
1594. J. H. Tuck, Pall-mall—Blowing apparatus. (A communication.)
1595. J. Newton, Birmingham, and W. Whittle, Smethwick —Axles.
1596. W. E. Newton, 66, Chancery-lane—Vices. (A communication.)
1597. W. E. Newton, 66, Chancery-lane — Mechanism for operating shuttles of looms. (A communication.)

Dated 17th July, 1855.

1598. P. Laroche, Seventham, Belgium — Rotary steam-engine.
1601. S. Salaville, Paris—Airing and preserving grain, seed, apples, &c.
1602. W. Jenner, Southwark—Beverage.
1603. H. S. Boase, Claverhouse, Dundee—Drying organic substances.
1604. A. Burdess, Rugby—Oil-feeders.
1605. E. Scragg, Buglawton, Congleton—Steam-engines.
1606. H. Huthnance, Stratford—Combustion of coals.
1607. E. Barry, Soho-square—Musical instruments played with a key-board, similar to that of a piano.

Dated 18th July, 1855.

1610. F. Hoyos, Paris—Roasting-spits.
1611. T. Almgill, Busby, near Glasgow—Printing on calico, &c.
1612. J. Reilly, Dublin—Iron hoops for casks.
1613. C. Toye, 42, Gloucester-street, Queen-square—Looms.
1614. W. Smith, Aston, Birmingham—Steel wire.
1615. T. Trapp, Mile-end—Connecting and disconnecting shafts. (A communication.)
1616. J. Ellis, Heckmondwicke—Ammonia, charcoal, animal and vegetable naphtha.
1617. J. Pollard, Bexley-heath—Gas.
1618. W. Ball, Ilkeston, and J. Wilkins, Nottingham—Warp fabrics.
1619. J. King and J. Holdsworth, Rochdale—Woven cotton fabrics.
1620. A. E. L. Bellford, 32, Essex-street, Strand—Condensing vapours or smoke. (A communication.)
1621. A. E. L. Bellford, 32, Essex-street, Strand—Induction and eduction valves of steam-engines. (A communication.)
1622. V. Scully and B. J. Heywood, Dublin—Cocks and taps.
1623. V. Scully and B. J. Heywood, Dublin—Locks, latches, and keys.

Dated 19th July, 1855.

1624. R. Martin, Reading, and J. C. Martin, 7, Pullen's-row, Islington—Obtaining pulp from wood.
1625. J. P. Clarke, Leicester—Metallic reels.
1626. S. B. Wright, Parkfieldstone, and H. T. Green, Moreton, both in Staffordshire—Bricks and tiles.
1627. J. G. Laurie, Glasgow—Steam-engines.
1628. P. Bertinetti, Paris—Projectile.
1629. D. and T. R. H. Fisken, Stockton-on-Tees—Tillage of land by machinery.
1630. E. A. Ferryman, Wadenhoe, near Oundle—Churn.
1631. J. Thompson and J. Mills, Manchester—Power-looms.
1632. J. H. Woolbert, Brussels—Madder and application. (Partly a communication.)
1633. J. H. Johnson, 47, Lincoln's-inn-fields—Transmitting motive power, principally to horse-mills. (A communication.)
1634. J. H. Johnson, 47, Lincoln's-inn-fields — Railway-breaks. (A communication.)
1635. J. H. Johnson, 47, Lincoln's-inn-fields—Reeds for weaving. (A communication.)
1636. T. Broadbent, jun., Crawford-street—Filtering liquids.
1637. M. F. Isoard, Paris—Generating steam.

Dated 20th July, 1855.

1640. H. D. P. Cunningham, Gosport—Reefing sails.
1642. J. H. Johnson, 47, Lincoln's-inn-fields—Motive power. (A communication.)
1644. G. Conner, Liverpool—Brushes.
1646. C. Deschamps and C. Vilcoq, Paris—Free diving boats.

Dated 21st July, 1855.

1652. R. M'Laren and S. W. Pugh, Peckham—Artificial fuel and fire lighters.
1654. C. Goodyear, 25, Avenue-road, St. John's-wood — Printing surfaces. (Partly a communication.)
1656. A. Dugdale, Paris—Locomotive engines.
1660. W. E. Kenworthy and H. Greenwood, Leeds—Screw-propellers.

Dated 23rd July, 1855.

1662. H. W. Ripley, Bradford—Finishing woven fabrics. (Partly a communication.)
1664. C. Goodyear, 25, Avenue-road, St. John's-wood — Moulded articles of compounds of india-rubber. (A communication.)
1666. C. Goodyear, 25, Avenue-road, St. John's-wood — Combs.
1668. A. Achard, Chatte, near St. Marcellus, France—Application of electricity as a transmitting agent of motive power.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

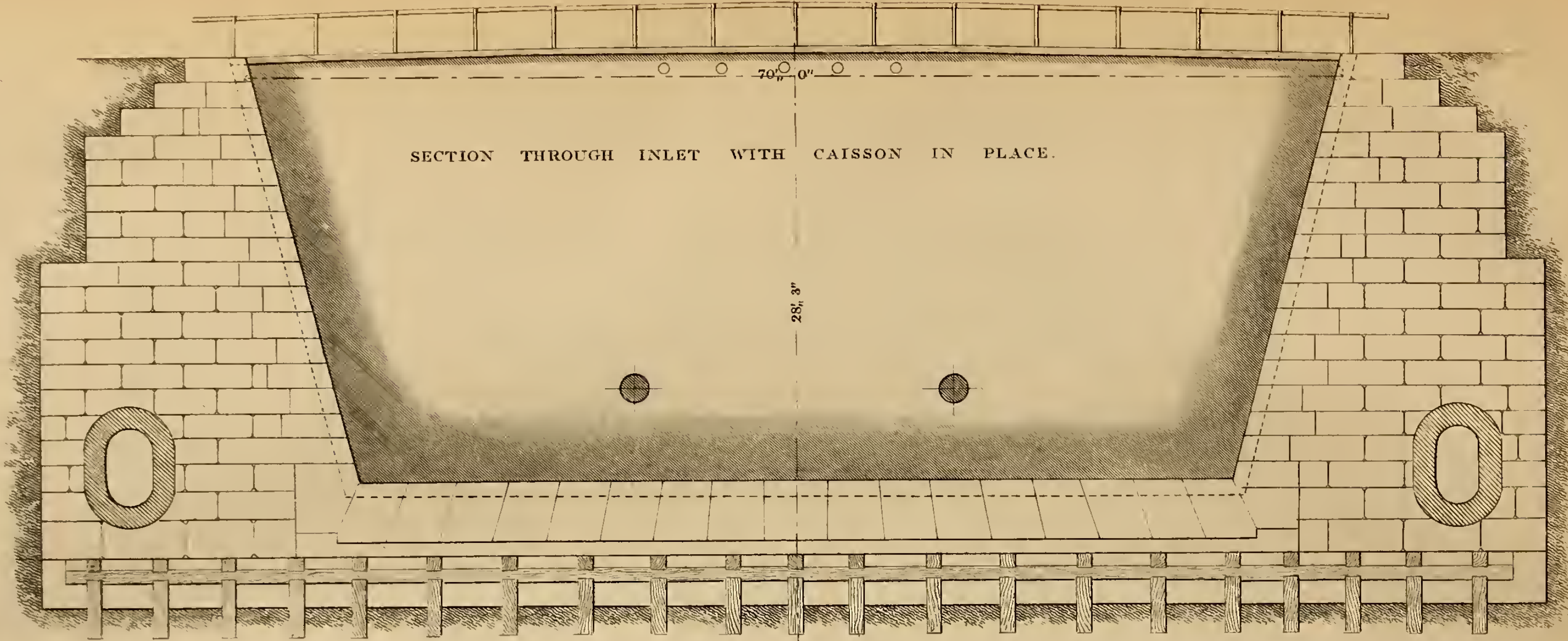
1567. Charles Byrne, Dublin—Preparation of fish, combined with pepper, wine, and other condiments, for sandwiches.—13th July, 1855.
1599. William Pidding, Putney—Coverings for the feet.—17th July, 1855.
1600. William Pidding, Putney—Manufacture of building materials.—17th July, 1855.
1658. J. Tildesley, Willenhall — Curry-combs.—21st July, 1855.
1735. N. Brough, Birmingham—Clasps and buckles. 31st July, 1855.

DESIGNS FOR ARTICLES OF UTILITY.

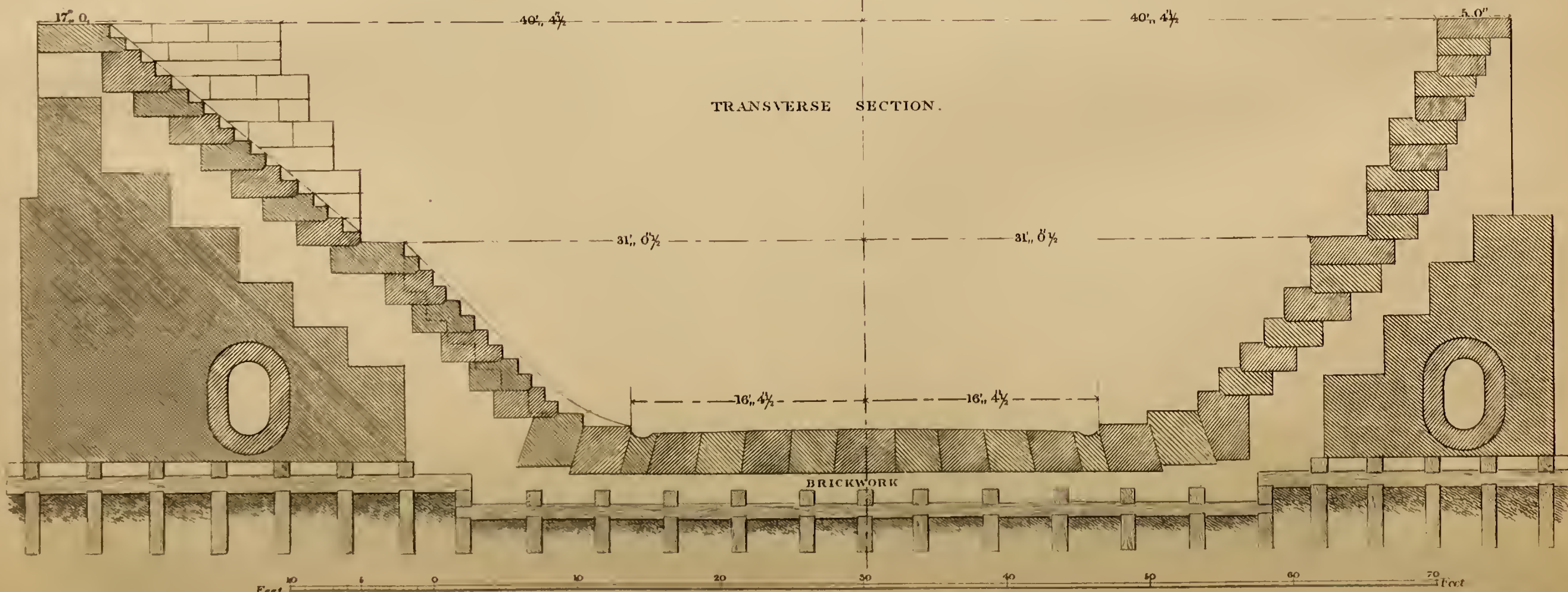
1855.

July 16. 3735. J. W. and T. Allen, 18 and 22, Strand, "Allen's wood trestle folding camp-bedstead."
" 16. 3736. Frederick William Ralph, 36, Throgmorton-street, "Envelope paper."
" 17. 3737. Albert Hatchett Jones, 19, Helmet-row, Old-street, "Grand universal safety pocket-detector for watches."
" 24. 3738. William N. Nicholson, Newark-upon-Trent, "Improved washing machine or churn."
" 24. 3739. Thomas Green, Leeds, "A 'Buddings' mowing machine."
" 27. 3740. John Singleton Copley Hill, Manchester, and Clement Coe, Leeds, "Improved camp cloak or coat, which also forms a tent suitable for military or other purposes."
Aug. 4. 3741. Isaac Shaw, 102, North-lane, Brighton, "New soap cutting machine."
" 8. 3742. Geo. Robert and John Bengough, 4, Tichborne-street, Piccadilly, "The improved mule portmanteau."

SOUTH INLET GRAVING DOCK, H. M. DOCKYARD, PORTSMOUTH.



SOUTH INLET GRAVING DOCK, H. M. DOCKYARD, PORTSMOUTH.



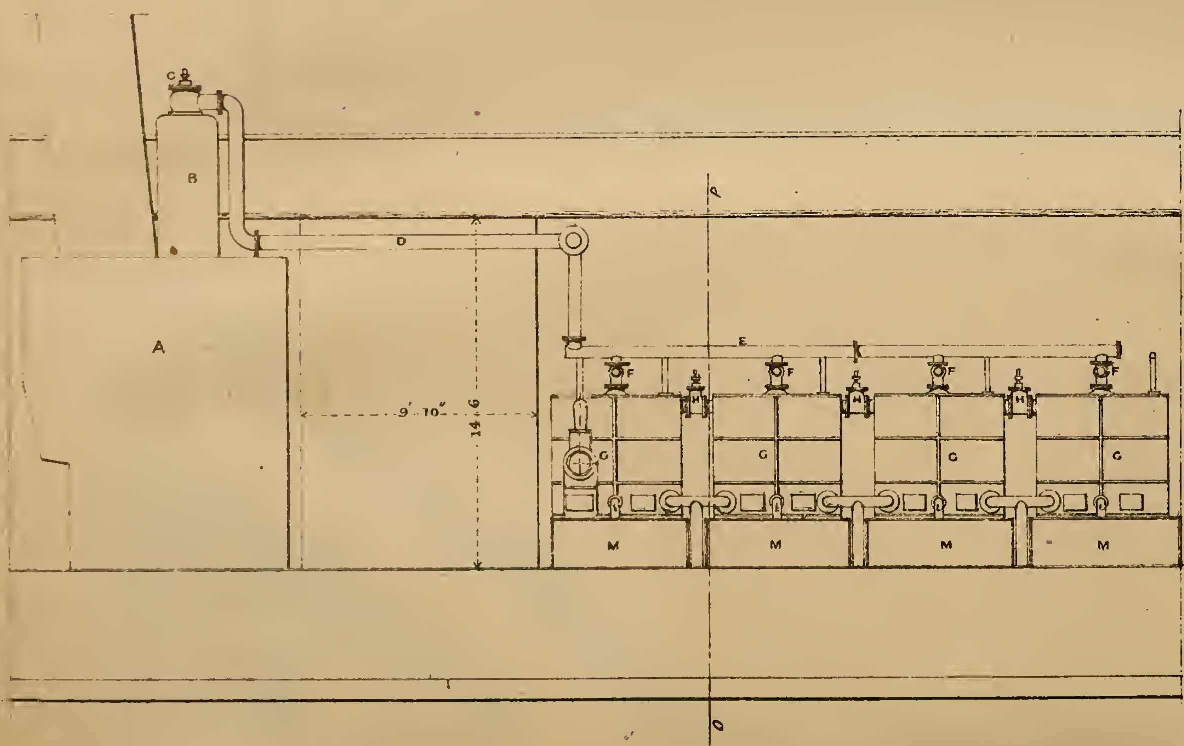
Engraved by C. Chabot.

CONDENSING APPARATUS

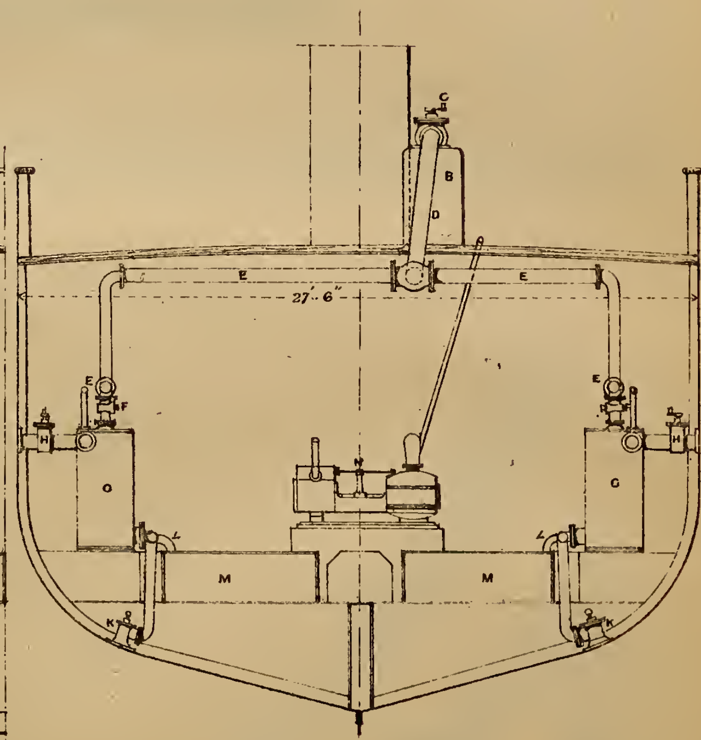
as arranged for

H. M. STEAM SHIP, "WYE."

LONGITUDINAL SECTION.



TRANSVERSE SECTION.



ALLEN'S

COMBINED - TRUNK
DOUBLE EXPANSIVE MARINE ENGINE.

ALLEN'S
COMBINED-TRUNK DOUBLE EXPANSIVE MARINE ENGINE.

Fig. 1. *Longitudinal Section and Elevation*

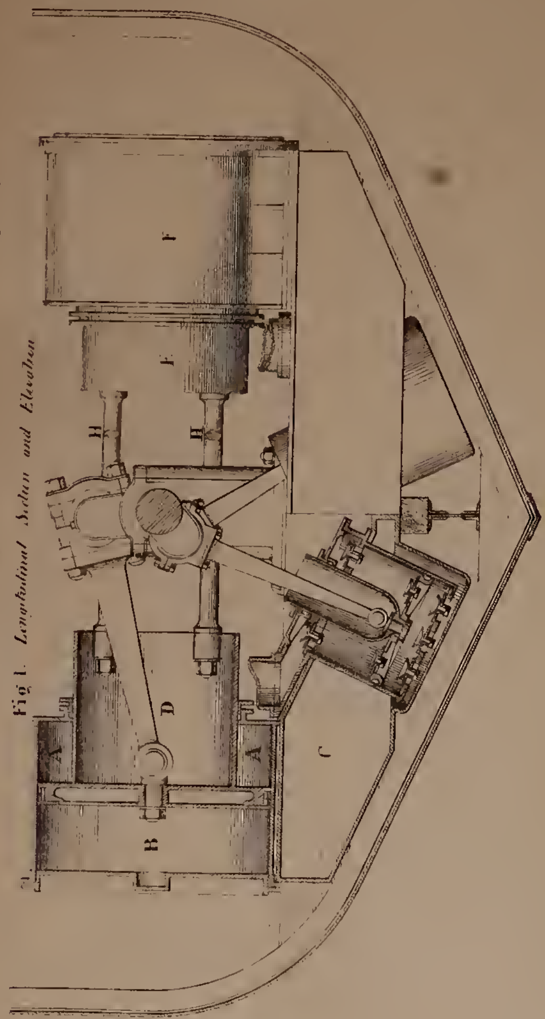
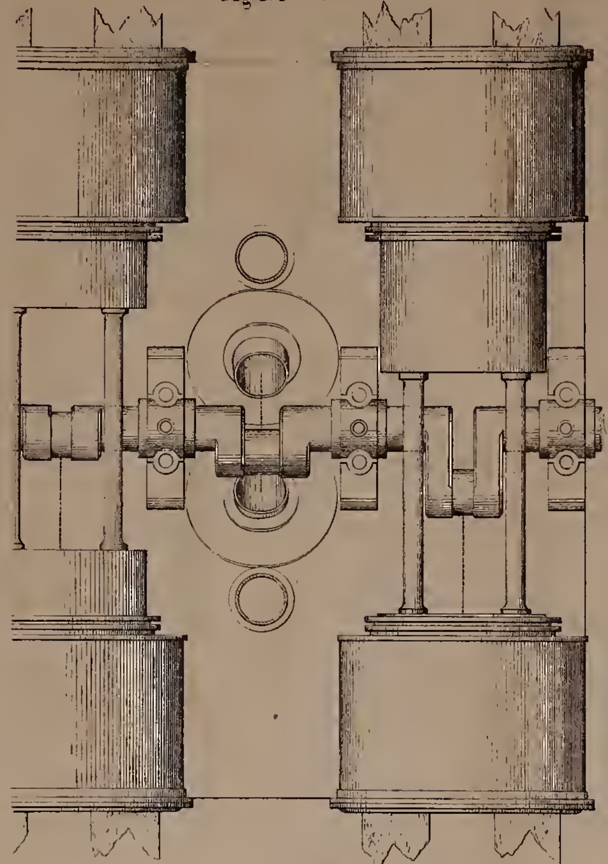


Fig. 2. *Plan.*



Scale 1/32nd

ALLEN'S
COMPOUND CYLINDER
COMBINED TRUNK ENGINE.
Fig. 3.

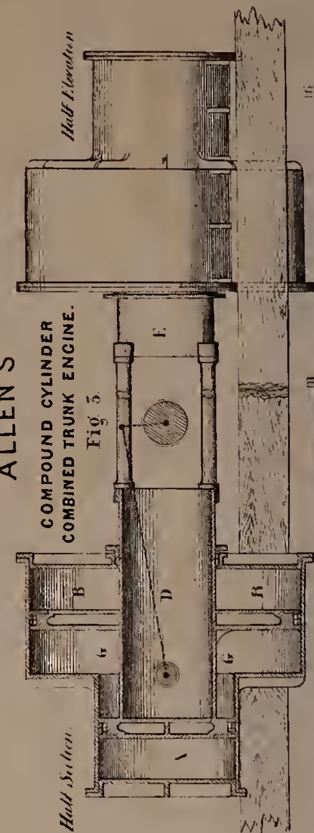
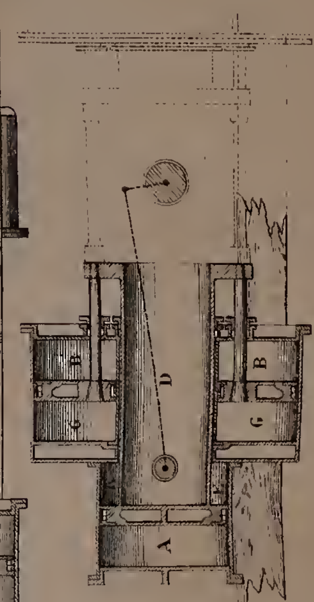


Fig. 4.
DOUBLE CYLINDER
TRUNK ENGINE.

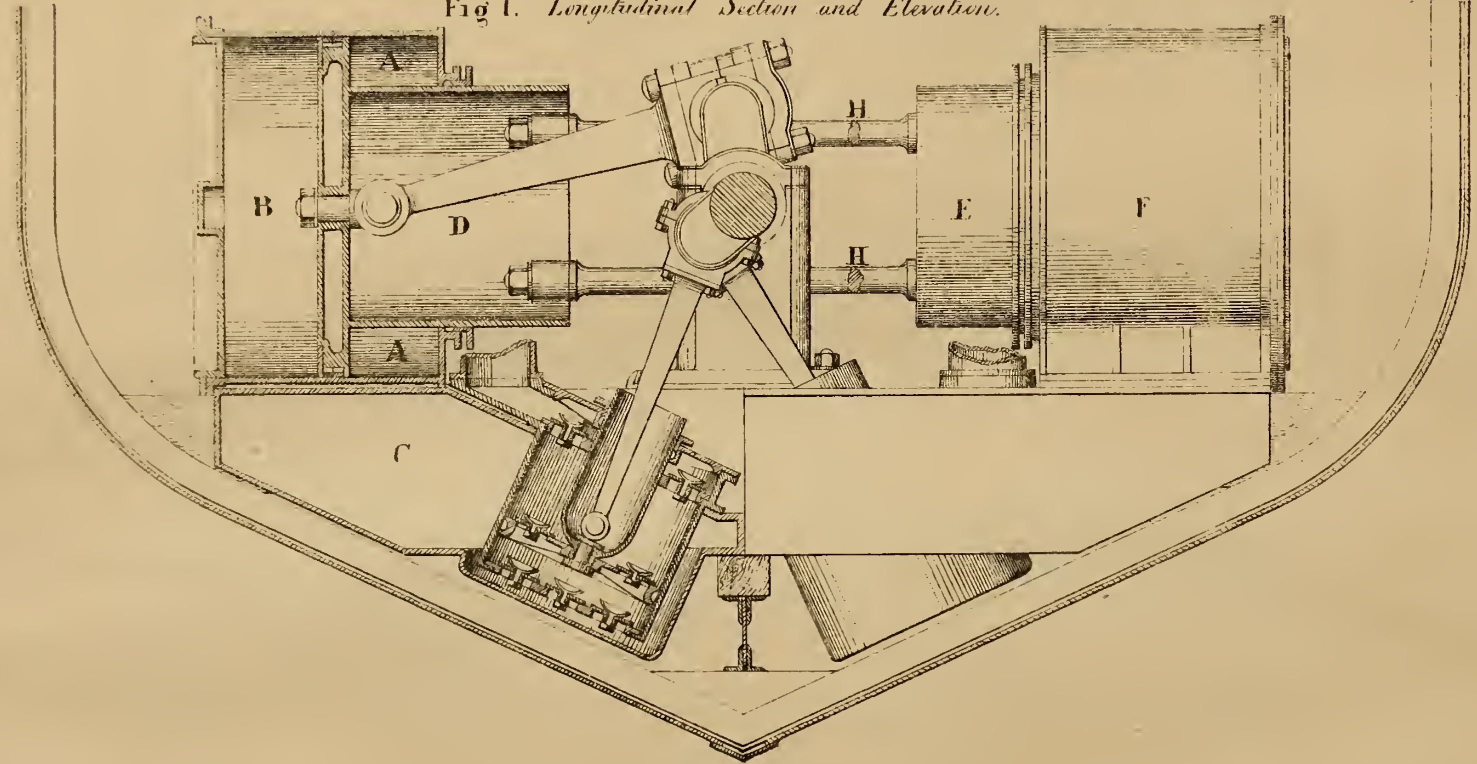


Scale 1/25th

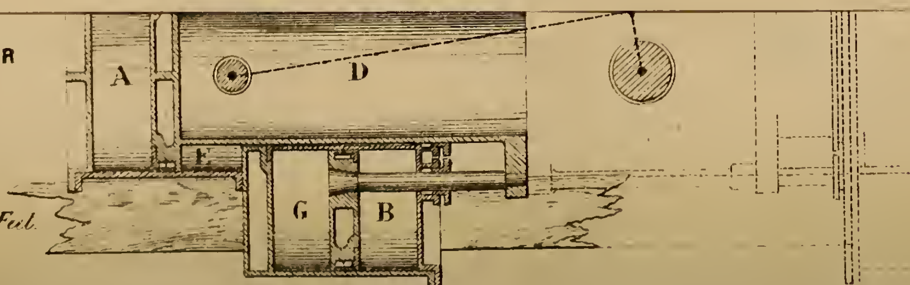
ALLEN'S

COMBINED-TRUNK DOUBLE EXPANSIVE MARINE ENGINE.

Fig 1. *Longitudinal Section and Elevation.*



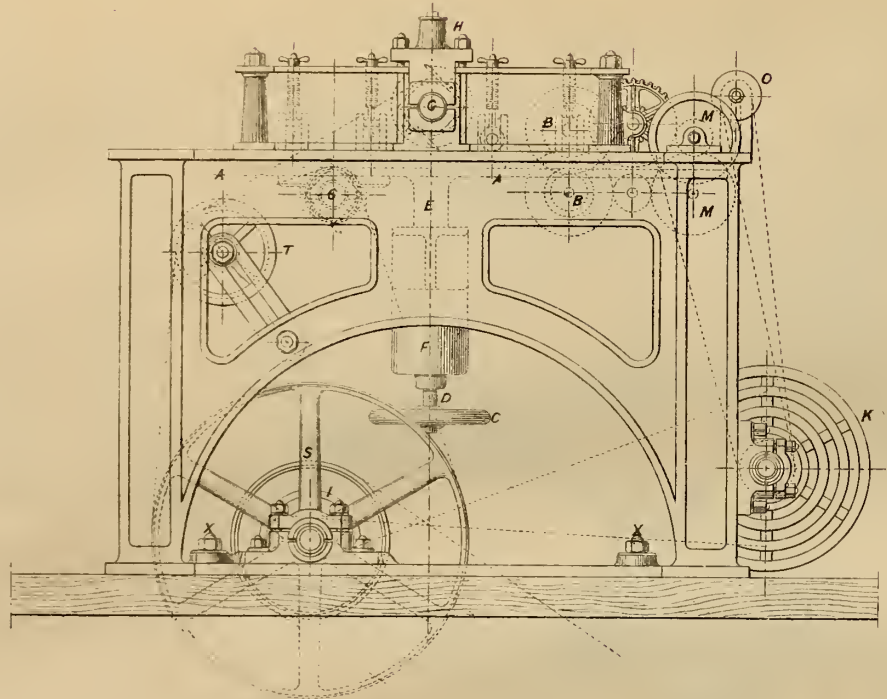
DOUBLE CYLINDER
TRUNK ENGINE.



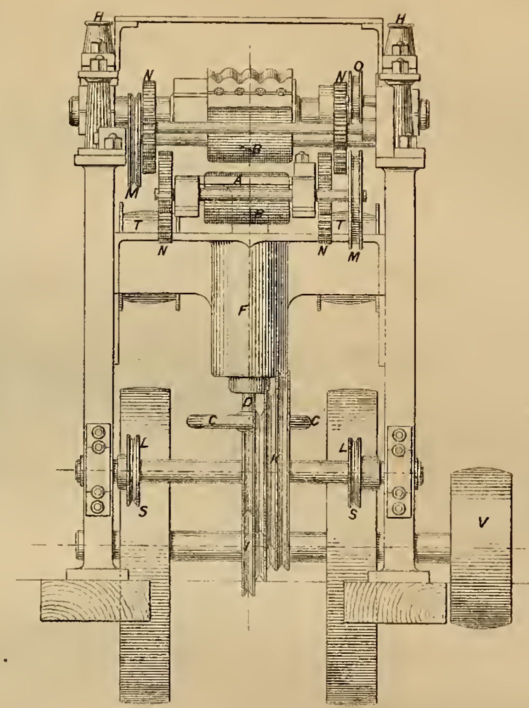
Scale 1/23rd

0 1 2 3 4 5 *Feet.*

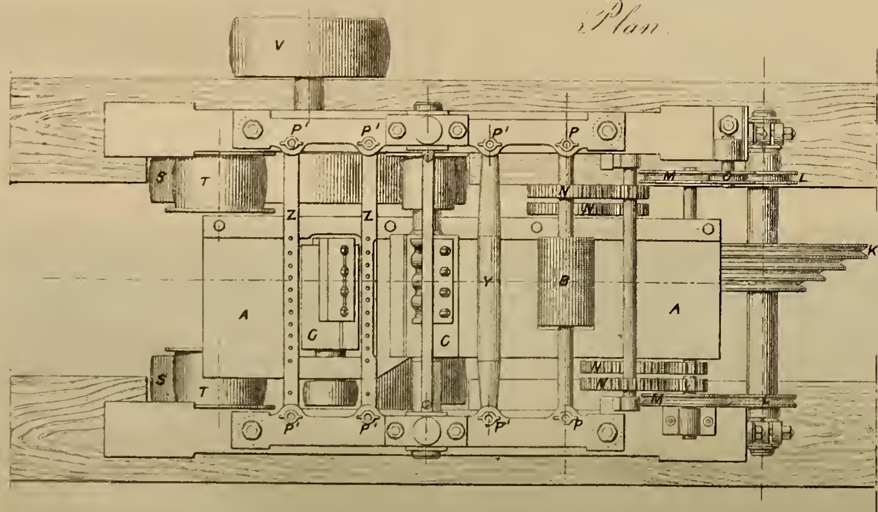
Side Elevation.



End View.



Plan.



MOULDING MACHINE

BY

MESS^{RS}. WORSSAM & C^{O}.

CHELSEA.

Inches 12 9 6 3 0 1 2 3 4 Feet

W^{m}. Smith C.E. direx^{t}

J. W. Lowry f.

Ashbee & Dangerfield Lith.
22, Bedford Street, Covent Garden.

THE ARTIZAN.

No. CLIII.—Vol. XIII.—OCTOBER 1st, 1855.

THE PARIS UNIVERSAL EXPOSITION, 1855.

CLASSIFICATION OF MANUFACTURES AND PRODUCTS OF INDUSTRY.

In all the branches of natural history the importance and value of a good system of classification have long been acknowledged. We see no good and sufficient reason why classification should not be equally extended to all the branches of human knowledge, and especially to those departments and applications of physical science which come more especially within the scope of this Journal. A clear and comprehensive arrangement of the various pursuits to which human industry is directed, in the adaptation of the powers or sources of power in nature, is one of the principal means which lead to an easy and safe progress: it serves materially to smooth the difficulties of the road, and often opens new ideas to the student, or serves to confine and concentrate his attention to certain points and within certain limits from which he might be injudiciously wandering. The classification of manufacturing industry which we are about to present to our readers has struck us as a model of comprehensive and enlightened investigation, which opens out to the mind of the Artizan and practical philosopher a vast field for the exercise of research and ingenuity, in which all the powers of the mind may seek and find a healthy action, and the study of which cannot fail to regulate, improve, and elevate.

The extent of the field thus opened is truly great; but however vast any enterprise or undertaking may be, one of the first and greatest difficulties is that of arrangement: and this arrangement once effected, the mind and the understanding seize at once the separate parts without confusion or distraction, and each distinct path may be pursued at will in a manner perfectly satisfactory. The student, the inventor, the mechanic, the labourer in any department of physical science, who carries with him a clear idea of the connexion and general arrangements of all the parts and branches of his subject, will be much better able to apply his intellect, to store his facts, and effect a real progress, than he who wanders on in a sort of intellectual confusion and obscurity, in which he does not see the mutual bearing and dependence of one subject or one branch of investigation upon the other.

The following is the classification adopted by the Imperial Commission to serve as the basis for forming collections of the products and manufactures of different nations:—

1st Group.—Industrial Employments having for their principal object the extraction or production of Raw Materials.

1st Class.—Art of mines and metallurgy.
2nd „ Art of the forester, of hunting and shooting, of fishing, and the storing of products obtained without cultivation.
3rd „ Agriculture.

2nd Group.—Industrial Occupations requiring the employment of Mechanical Forces.

4th Class.—General mechanics applied to industry.
5th Class.—Special application of mechanics to railways and other modes of transport.
6th „ Special application of mechanics to the industry of workshops.
7th „ Special application of mechanics to the manufacture of woven fabrics.

3rd Group.—Industrial Arts specially founded on the employment of Physical and Chemical Agents, or connected with the Sciences, and with the departments of Teaching.

8th Class.—Arts of precision relating to the exact sciences and to teaching.
9th „ Industrial occupations relating to the economical production and employment of heat, light, and electricity.
10th „ Chemical arts, dyeing and purifying of tissues; industrial occupations relating to paper, skins, leather, and caoutchouc.
11th „ Preparation and conservation of substances used for food.

4th Group.—Industrial Occupations confined especially to the Learned Professions.

12th Class.—Arts of hygiene, pharmacy, medicine, and surgery.
13th „ Naval and military arts.
14th „ Civil constructions.

5th Group.—Manufactures of Mineral Products.

15th Class.—Manufacture of steel, plain and ornamented.
16th „ Fabrication of works in metal.
17th „ Gold and silver smiths' work; jewellery; manufacture of artistic bronzes.
18th „ Manufacture of glass and pottery.

6th Group.—Manufacture of Tissues.

19th Class.—Cotton manufacture.
20th „ Woollen and worsted do.
21st „ Silk do.
22nd „ Flax and hemp do.
23rd „ Hosiery, carpet making, embroidery and lace making; gold and silver fringe making.

7th Group.—Furniture and Decoration; Designs for Ornamentation of Fabrics; Printing and Music.

24th Class.—Occupations relating to furniture and decoration.
25th „ Articles of clothing; objects of fashion and fancy.
26th „ The arts of modelling and drawing applied to manufactures; printing from types and from copper-plates; photography.
27th „ Manufacture of musical instruments.

All these classes are divided into sections, which it will be unnecessary to particularise, except for those classes with which the Artizan is more immediately concerned. The principal of these are Classes 4, 5, 6, 8, 9, and 14.

Class 4 is thus subdivided:—

1st Section.—Apparatus for weighing and gauging:—

Balances, steelyards, and weighing machines of all kinds.

Machines for gauging water:

Gauging-tubes and other hydrometers.

Machines for gauging or measuring gases:

Anemometers, gas-meters.

Manometers.

Dynamometers of all kinds.

2nd Section.—Apparatus for regulating the transmission of mechanical forces:—

Detached apparatus for general purposes:

Apparatus for transmitting motion in machinery.

Apparatus for diminishing friction.

Special apparatus relating to the flow of liquids.

Special apparatus relating to the flow of gas.

Regulators.

3rd Section.—Machines for utilising and applying the work of animals:—

Horse-powers, fixed and portable.

Wheels and other apparatus worked by animal power.

4th Section.—Windmills:—

Mills with a horizontal axis:

Self-regulating and self-trimming mills.

5th Section.—Machines moved by the action of water:—

Wheels with a horizontal axis:

Water-wheels with plain and curved float-boards.

Wheels with a moveable axis; special regulators.

Wheels with a vertical axis:

Wheels with vanes.

Turbines.

Machines acted on by a column of water.

6th Section.—Machines worked by steam and gas:—

Boilers for the production of steam:

Boilers with interior furnace.

Boilers in which the water circulates; tubular boilers; apparatus for supplying fuel; safety apparatus.

Fixed steam-engines:

Vertical engines, horizontal engines, oscillating and rotary engines.

Portable engines.

Travelling engines.

Marine engines.

Locomotive engines. (*See* Class 5.)

Machines worked by the vapour of ether, chloroform, or other volatile liquids; machines worked by combined vapours.

Machines worked by gas and by heated air.

7th Section.—Machines for lifting and transporting heavy weights:—

Pulleys, blocks and tackle.

Crabs, shear-poles, hydraulic crabs.

Cranes, fixed and moveable; cranes placed on wheels and on boats, &c.

Windlasses and capstans—machinery of quarries.

Travelling cranes.

8th Section.—Hydraulic machines for raising water; scoops worked by hand or machinery, apparatus for drainage of low lands:—

Chain pumps.

Pumps of all other kinds:

Pumps for domestic use, pumps used in horticulture and for purposes of watering plants.

Large pumps used for supply of water to towns and factories.

Pumps used for extinguishing fires.

Pumps used in mines.

Drums, Archimedian screws, bucket-wheels, and other apparatus for raising water through small heights.

Hydraulic rams.

Machines for raising water by centrifugal force.

9th Section.—Ventilating and blowing machinery:—

Fans, bellows, ventilators, and aspirators.

Blowing machines.

Machines in which dilated and compressed air are used to produce mechanical effects.

Class 5 is divided into Eight Sections, as follows:—

1st Section.—Machinery for the transport of burdens, supported by the arms, on the back or on the head:—

Contrivances for the use of a single individual; mode of securing wallets, knapsacks, &c., by means of straps; apparatus for the transport of two burdens balanced by the aid of a lever, &c.

Apparatus for the use of two or more individuals; hand-barrows of all kinds; various apparatus for bearing burdens on the shoulders.

2nd Section.—Harness and saddlery:—

Objects in metal fabricated expressly for the use of the harness-maker and saddler: bits, curbs, spurs, stirrups, buckles, rings, &c.

Pack-saddles of all descriptions.

Ordinary saddles.

Harness for beasts of burden.

Harness for beasts of draught.

Driving and riding whips.

Ornamental saddlery.

Process of manufacturing saddlery.

Saddle-bags, portmanteaus, and other articles used for transport by beasts of burden.

Trunks, bags, portmanteaus, &c., used for transport in carriages.

3rd Section.—Materials and apparatus used in building carts, waggons, and carriages:—

Axletrees.

Wheels, axle-boxes, and bands.

Systems of suspension by springs of wood, leather, steel, &c.

Preparation of wood and basket work for the bodies, boots, and heads of carriages.

Fittings of iron and other metals.

Leather, tissues, and other materials for lining, &c.

Systems of harnessing animals.

Apparatus relating to harness for purposes of traction.

4th Section.—Cart and waggon building (*charronage*):—

Hand-barrows.

Sledges.

Wheel-barrows.

Hand-carts with two or four wheels.

Drays.

Carts.

Foraging-carts, &c.

Carts for carrying furniture, sand, gravel, night-soil, &c.

Watering-carts, barrel-carts, and carriages for the transport of liquids.

Waggons and carriages for carrying timber, dressed stone, statues, locomotive engines, &c.

Railway-waggons. (*See* 7th Section.)

5th Section.—Carriages:—

Sedan-chairs, palanquins, litters, carriages for children, invalid carriages, &c.

Pleasure-sledges.

Carriages put in motion by cranks, velocipedes, &c.

Public carriages:—

Special carriages for the transport of dispatches.

Diligences.

Omnibuses.

Railway-carriages. (*See* 7th Section.)

Travelling carriages.

Town carriages with two and four wheels.

Pleasure carriages.

State carriages.

6th Section.—Materials for transport adapted to confined spaces:—

Temporary rails and waggons for use in earthworks, mines, &c. (*See* Classes 1 and 14.)

Small railways and waggons for use in factories.

Small railways established in common roads, and carriages adapted to this kind of railway.
Automotive or self-moving machines.
Materials of transport by slings.
7th Section.—Materials of railways:—
Materials of the permanent way.
Rails and chairs.
Sidings and turn-plates.
Locomotive engines:
Various parts composing locomotives.
Engines for high speeds.
Engines for medium speed.
Engines with low speeds for carrying goods.
Tenders.
Locomotive with tender combined.
Fixed engines for inclined planes, and self-acting inclines.
Materials of the atmospheric system.
Rolling plant:
Passenger-carriages.
Carriages for goods and animals.
Earth-waggons.
Apparatus for preventing shocks.
Apparatus for signals.
Machines and apparatus for feeding the engines with water.
Machines and apparatus used on passenger-platforms.
Machines and apparatus used on goods-platforms, cranes, &c.
Special machines and apparatus used in workshops of construction and repair.
Tables and documents relating to the execution of railways.
8th Section.—Materials of transport by water.
9th Section.—Aërostatics.
Mongolfiers and balloons.
Apparatus for aërial navigation.

Class 6 is thus divided:—

1st Section.—Detached parts and elementary machines:—
Detached parts for the construction of machines of this class.
Utensils and machines for crushing, grinding, pulverising, milling, sawing, polishing, planing, &c.
Presses of all kinds.
2nd Section.—Machines used in working mines:—
Apparatus for sinking and boring; crabs and boring-machines.
Machines for raising minerals and water.
Safety apparatus for the descent into mines and coal-pits.
3rd Section.—Machines relative to the art of construction:—
Machines for the preparation of cements and mortars.
Engines for driving and extracting piles.
Excavating and other machines used in executing earthworks.
4th Section.—Machines used for working minerals:—
Implements and utensils used in working and dressing all kinds of stone, marble, granite, plaster, &c.
Machines for the preparation of earths, and the fabrication of bricks and tiles; machines for making draining-tiles.
Machines used in glass-works and pottery.
Implements and tools used in working the precious stones.
5th Section.—Machines used in metallurgy:—
Machinery of rolling-mills; hammers, sledges, rollers, shears, slitting machines, &c.
Machinery used in iron-foundries.
Machinery used in the preparation of other metals besides iron.
6th Section.—Materials used in workshops for works of mechanical construction:—
Awls and gouges.
Tools for planing and mortising.
Tools for boring and carving.
Tools for cutting screws and threads.
Tools for rivetting. Special machines or tools.
7th Section.—Machines or implements for the fabrication of small articles in metal:—
Machines for wire-drawing.
Machines for making nails, sprigs, screws, needles, pins, and metal chains.
Special machinery for the fabrication of coins and medals.
Machinery for making buttons.
Machinery used in workshops for carving and embossing.
8th Section.—Machinery used for working in wood:—
Fixed and portable saws of all kinds.
Machines for splitting and cutting up wood.
Machines for bending and shaping wood.
Machines for planing both plane and curved surfaces.
Machines for cutting up wood.
Tools and chisels for working wood into various shapes.
9th Section.—Agricultural machinery, and implements used in the preparation and cultivation of food:—
Cultivating machines of all kinds for the preparation of the soil, for weeding, sowing, thrashing, preparation of roots and fodder.
Machinery and apparatus employed in grinding and baking.
Winnowing machinery.
Salting and curing apparatus; materials used in breweries and distilleries.
Apparatus used in the manufacture of sugar.
Apparatus used in the manufacture of chocolate and sweetmeats.
10th Section.—Chemical arts:—
Apparatus employed in the fabrication of chemical products, soap and candles.
Apparatus employed in the preparation of skins and leather
Apparatus employed in the preparation of caoutchouc and gutta-percha.
Apparatus employed in the preparation of paper.
11th Section.—Arts of colouring and printing:—
Workshop apparatus used for coloured paperhangings.
Apparatus used in making embossed papers, ornamental, and other papers used in binding.
Presses and other machines for printing in typography, lithography, and copper-plate.
Special machinery used for type-founding, the casting of stereotypes and the preparation of *clichés.*
Machines for copying letters and ruling paper.
12th Section.—Special machines applicable to certain arts:—
Machines employed for making shoes.
Machines employed in sculpture and engraving; lathes, and other apparatus for watchmaking.
Apparatus for working in ivory, horn, tortoiseshell, papier-mâché, &c.

The 8th Class is divided into Seven Sections, as follows:—

1st Section.—Weights and measures—apparatus for measuring and calculating:—
Standards of weights and measures; documents of all kinds relating to the comparison of weights and measures employed in different countries.
Measures of length; apparatus for accurate determinations of length, verniers, micrometers, &c.
Weights and balances of precision.
Measures of capacity.
Moneys.
Tables and documents of all kinds presenting a methodical comparison for calculation.
Apparatus indicating by graphic representation the results of calculation, logarithmic tables, abaci, &c.
Calculating machines; mechanical counters of all kinds.
Apparatus for measuring time; water-clocks, hour-glasses, &c.
2nd Section.—Clocks and watches:—
Detached parts of clocks, with a collection of the tools employed in making them.

Detached parts of clocks, presented as specimens of improvement in the art; systems of compensation, escapement, &c.
Clocks of cheap construction adapted for the use of workmen and the rural population.
Clocks and watches manufactured for particular markets.
Large clocks for churches and other public establishments.
Clocks and watches for ordinary use.
Timepieces performing with great accuracy.
Watches of all kinds with seconds hands.
Chronometers for use in the navy.
Chronometers, clocks, and watches for astronomical purposes.
Regulators.
Various applications of clockwork.
Apparatus for registering natural phenomena.
Complex clocks, indicating the principal elements of motion in the solar and lunar systems, the golden number, &c.
Electrical clocks.

3rd Section.—Optical instruments and apparatus of all kinds for the measurement of space :—
Detached parts of optical apparatus; achromatic glasses, object-glasses, &c.
Tools employed in making mathematical instruments, machines for dividing the straight line, the circle, &c.
Apparatus used for astronomical observations; telescopes with their adjuncts, mural circles, &c.
Apparatus used in the art of navigation; sextants, octants, reflecting and repeating circles, compasses, sounding leads, &c.
Instruments used in geodesy and topography; theodolites, repeating circles, geodesical signals, apparatus for measuring bases, spirit-levels, &c.
Instruments for topographical reconnaissances and rapid sketches; circles, spirit-levels and pocket compasses, military glasses, &c.
Microscopical and micrometrical apparatus.
Apparatus employed in the study of the natural sciences; goniometers, &c.
Apparatus for polarisation and refraction of light; various applications to science and the arts.
Surveying instruments; plane tables, circumferenters, compasses, levels, chains, poles, levelling telescopes, &c.
Instruments for ordinary use; eye-glasses, opera-glasses, spectacles, telescopes, &c.
Solar microscopes, camera obscuras, magic lanterns, phantasmagoriæ, &c.
Camera lucidas, kaleidoscopes, &c.

4th Section.—Apparatus used in physical science, chemistry and meteorology, and designed for the study of the sciences as applied to ordinary purposes:—
Apparatus for measuring mechanical forces, dynamometers, &c.
Apparatus for measuring volumes, masses, and densities; aërometers, &c.
Apparatus and instruments for the study of physical phenomena relating to molecular action, to acoustics, light, heat, electricity, magnetism, &c.
Apparatus for the measurement of physical phenomena, and for the observation of meteorological phenomena; thermometers, barometers, pyrometers, udometers, &c.
Apparatus of all kinds employed in chemical laboratories.
Apparatus adapted for the cultivation of physical science, of chemistry and natural history; apparatus used in scientific voyages and expeditions.
Various apparatus; sun-dials, meridians, &c.

5th Section.—Charts, models, and documents relating to astronomy, geography, topography, and statistics :—
Celestial and terrestrial globes of all kinds.
Charts and plans in relief.
Planispheres, sidereal charts, lunar charts, &c.
Marine and hydrographical charts.
Geographical charts.
Topographical charts.
Topographical and cadastral maps.
Physical charts of every kind.
Almanacks.
Ephemerides and tables of all kinds for the use of astronomers, mariners, geographers, &c.
Tables relating to levelling and other operations for the use of engineers.
Tables of mortality and other statistical documents for general use.

6th Section.—Models, charts, books, instruments, and apparatus for teaching the sciences, the classics, and the liberal arts :—
Apparatus for teaching geometry, astronomy, geography, &c.
Apparatus for teaching mineralogy; collections of minerals, rocks, and fossil organised bodies; special treatises; drawings and models of crystals, &c.
Apparatus for teaching botany; collections of herbs, special treatises, systems of gardening.
Apparatus for teaching zoology; collections of animals and zoological preparations of all kinds; arrangement of zoological gardens, special treatises, &c.
Apparatus for teaching the physical sciences, chemistry and mechanics, surgery, medicine, pharmacy, veterinary surgery, &c.
Apparatus for teaching the art of mining, of agriculture, technology, &c.
Apparatus for teaching the classics, the liberal arts, &c.

7th Section.—Apparatus for elementary instruction :—
General and detailed plans for teaching establishments.
Special dispositions providing for health and cleanliness.
Books and apparatus for teaching reading, writing, arithmetic, geography, &c.
Books and apparatus for teaching drawing and music.
Books and apparatus for teaching the useful arts, especially sewing and knitting, and occupations necessary for the agricultural labourer.
Special apparatus for teaching the blind, and the deaf-and-dumb.

The 9th Class is divided into Nine Sections.

1st Section.—Processes which employ natural sources of heat, cold, light, and electricity :—
Central heat, transmitted by warm springs, Artesian wells, &c.
Heat or cold of the soil employed in cellars, wells, cisterns, &c.
Heat or cold of the air, and of surface waters; ventilation by currents of air; art of collecting, transporting, and preserving ice and snow; ice-houses, &c.
Solar heat and light:
Systems of lenses and burning glasses.
Illumination of dark places by transmission, and by reflection.
Electric and various other meteorological agents; means of usefully employing these agents, and preventing injurious effects from them; lightning conductors, &c.

2nd Section.—Processes for the initial production of fire and light:—
Original means, by friction, percussion, the employment of tinder and similar substances, matches, &c.
Apparatus for producing fire and light by physical and chemical reaction of a complex nature; by means of gas, &c.
Matches and tinder prepared for instantaneous illumination by means of friction.
Various combustibles collected and prepared specially for lighting; fir cones, resinous products, &c.

3rd Section. — Combustible materials for economical and domestic heating :—
Combustible mineral substances prepared for combustion in various forms: coke; artificial and patent fuel formed of coal-dust, &c.; compressed and carbonised turf, &c.
Combustible vegetables, prepared for immediate use: wood, sawn and split; coal, &c.

Combustible animal substances prepared for immediate use: dung of animals, &c.
Bituminous and resinous matters employed as combustibles.
Various combustibles: gas, natural and artificial; metallic sponges, &c.

4th Section.—Heating and ventilation of houses:—
Fireplaces, fixed and moveable, heating chiefly by direct contact of the gas consumed.
Fireplaces heating by direct radiation from the combustible matter.
Simple pipes or flues.
Flues with moveable fireplaces.
Stoves and flues, &c.
Flues or pipes radiating heat at certain points.
Stoves or apparatus for heating, chiefly by radiation from the case enclosing the fire.
Simple fixed stoves.
Stoves made with openings.
Portable stoves.
Apparatus and utensils employed in fireplaces, stoves, grates, &c., for exciting and regulating combustion, and for preventing smoke—as bellows, tongs, pokers, shovels, &c.
Apparatus for heating by the intervention or transmission of hot air:
Of steam.
By the circulation of hot water.
By means of other vehicles.
Apparatus for ventilating and cooling dwelling-houses.

5th Section.—Production and employment of heat and cold for domestic purposes:—
Ovens, fixed and portable, for securing interior heat, as applied in baking bread, and various other alimentary preparations.
Kitchen stoves and ranges, with their appendages.
Special apparatus and contrivances for roasting meat.
Apparatus for cooking food by contact with heated bodies, as gas, heated iron, &c.
Special apparatus for combining the cooking of food with domestic heating.
Various heating apparatus employed for domestic purposes:
Chafing-dishes for the use of the table.
Feet-warmers.
Warming-pans.
Apparatus for washing and finishing domestic linen, washhouses, &c.
Apparatus for cooling water and other beverages.
Apparatus for the artificial production of ice.

6th Section.—Production and employment of heat and cold in the arts:—
Furnaces and other apparatus for heating, fusion, calcination, and sublimation of solids.
Generators of steam; boilers, safety apparatus, means for preventing incrustation, &c.
Apparatus for heating, evaporating, and distilling liquids; alembics, condensers, retorts, &c.
Apparatus for drying and heating by means of gas; employment of stoves, &c.
Special apparatus for the production and employment of heat in small quantities; small pipes for conveying gas, eolipiles, spirit-lamps, &c.
Refrigerating apparatus of all kinds.

7th Section.—Lighting:—
Lighting by means of solids:
Wood variously prepared; resin, tar, &c.
Materials and mode of preparing unctuous and fatty substances for making candles, matches, &c.
Articles prepared for lighting with a basis of tallow, with and without a mixture of resin; candles, lamps, &c.
Spermaceti, stearine, and wax candles; apparatus used in the manufacture of these, of wax matches, &c.
Candles made of animal and vegetable wax; tapers and matches of wax, &c.
Apparatus used in lighting by means of solids; chandeliers, snuffers, lanterns, reflectors, skylights, &c.
Lighting by means of liquids:
Apparatus and process of preparing oils, spirits, &c., for lighting purposes.
Mineral, vegetable, and animal oils, raw and prepared, for lighting.
Essential oils, mineral and vegetable.
Mixtures of alcohol and essential oils; various compositions of liquids used for lighting.
Lamps contrived for lighting by means of liquids:
Lamps burning the fixed oils.
Lamps burning the volatile liquids.
Apparatus used for lighting by means of liquids; glass chimneys, globes, skylights, &c.
Gas-lighting:
Materials and process for making and purifying coal-gas.
The same for oil-gas.
The same for resin-gas.
Production of gas from various other matters, as the hydrocarburets, wood and coal, with reaction of steam, &c.
Apparatus for storing gas; gas-holders, &c.
Apparatus for distribution and transport of gas; pipes, valves, meters, &c.
Apparatus relating to the consumption of gas; burners, chimneys, &c.

8th Section.—Lighthouses, signals, and aërial telegraphs:—
General modes of constructing lighthouses.
Illumination of lighthouses:
Various lamps, coloured fires, &c.
Machinery and apparatus connected with illumination of lighthouses.
Apparatus for working revolving lights, eclipses, &c.
Various systems of conveying signals.
Telegraphs for day.
Telegraphs for night.

9th Section.—Production and employment of electricity:—
Galvanic piles.
Electrical lighting.
Electric telegraphs:
Systems of electric telegraph, in the air, subterranean, and submarine.
Apparatus for transmitting telegraphic messages; dials, keys, needles, cylinders, &c.
Application of electricity to domestic and manufacturing purposes; electric bells, clocks, &c.
Application of electricity to purposes of correspondence, and as a means of preventing accidents on railways.
Motion produced by electricity.
Application to metallurgy:
General application to the solution and precipitation of metals.
Galvano-plastic moulds.
Gilding and silvering by electricity.

Class 14 is divided into Nine Sections, as follows:—

1st Section.—Building materials:—
Building stones, marbles and slates, both in the rough state and dressed in readiness for building purposes.
Mortars, cements, and hydraulic lime, in different stages of preparation; artificial hydraulic lime, Puzzolana, sand, &c.
Specimens of mortar and *béton* (concrete), and mode of preparing same.
Aluminous, silicious, and other plasters, stuccos, &c.
Pottery employed for building purposes, as tiles solid and hollow, bricks, pipes, paving bricks and tiles, &c.
Ornamental pottery and earthenware.
Natural and artificial asphalte and bitumen.
Metals and wood used for building.

2nd Section.—Various arts relating to building :—
Earthwork. Tools used by excavators, as picks, shovels, beetles, &c.
Levers, blasting tools, safety fuses, and other apparatus used in quarrying.
Application of electricity to blasting and raising rocks from under water.
Machines used in executing earthworks.
Disposition and arrangement of materials in large earthworks.
Masonry :
Tools and apparatus employed by masons, stone-dressers, and plasterers.
Specimens of work ; modes of dressing and cutting stone.
Marble work :
Tools and apparatus employed by workers in marble.
Specimens of marble used in building.
Chimney-pieces, brackets or consoles, and tops of tables, &c.
Carpentry :—
Carpenters' tools, fixed and moveable benches.
Works of carpentry, as roofs, centres, staircases, &c.
Iron-work :
In roofs, floors, columns, &c.
In fastenings of doors and windows, gratings, shop-fronts, &c.
Joinery :
Works of joinery in doors and windows, in outside and inside blinds, &c.
Inlaid floors, mouldings, &c.
Specimens of workmanship for windows, glass roofs, and panels of wood painted and grained to imitate marble, oak, &c.
Employment of asphalte and bituminous mastics :
Coating of terraces, walks, and walls.
Mosaic pavements.
Employment of bitumen for inlaid floors, mosaics, &c.
3rd Section.—Foundations :—
Foundations on concrete, on natural and artificial stone, on gravel, sand, &c.
Piles, coffer-dams, caissons.
Pile-engines and machinery for extracting piles.
Pneumatic apparatus, iron piles and caissons.
Diving-bells, submarine boats, machines and apparatus for exploring and working under water.
4th Section.—Works relating to maritime navigation :—
Plans of roads, ports, and harbours.
Lighthouses and beacons.
Protection of banks ; works of piling, pitching, and fascining ; locks and scouring basins.
Breakwaters, jetties, piers.
Quays, basins, wet docks.
Graving and repairing docks.
Warehouses and docks for commercial purposes.
5th Section.—Works relative to inland navigation :—
Plans and sections of canals and rivers.
Embankments and works of protection against rivers.
Canal-feeders, reservoirs, dams and sluices.
Locks, gates, inclined planes, apparatus and arrangements for passing boats from one level to another.
Canal bridges, &c.
Apparatus and machines for dredging and cleansing in harbours, rivers, and canals.
Ferry-boats and contrivances for crossing rivers.
Rafts, boats, and other means of transport on rivers.
6th Section.—Roads and railways :—
Plans and sections of roads ; systems of construction.
Materials for constructing and repairing paved highways with stone, wood, and bitumen.
Sweeping-machines and other apparatus for cleansing streets and roads.
Seats, fountains, mile-posts, direction-posts, &c.
Plans and sections of railways; systems of construction.
Permanent way, crossings, rails, chairs, &c.
Turnplates and travelling platforms.
Designs and models of viaducts and other structures.
Platforms and stations, engine and carriage sheds, warehouses and establishments for loading and unloading goods.
Water-tanks, hydraulic cranes.
Level crossings, gates, gatekeepers' lodges, &c.
Moveable plant, safety apparatus, self-acting machinery for sidings ; signals of all kinds.
7th Section.—Bridges :—
Bridges of masonry.
Wooden and iron bridges.
Suspension bridges.
Swing bridges, floating bridges, temporary bridges.
Bridges built of boats.
8th Section.—Distribution of water and gas : —
Mode of taking water from rivers.
Information relating to springs and wells.
Artesian wells and apparatus for boring.
Engines for raising water.
Aqueducts and pipes for conveying and distributing water.
Hydrants, sluice-cocks, floats, and ball-valves.
Public fountains.
Apparatus for filtering on the large scale.
Construction and arrangement of great and small sewers, and open drains for the conveyance of sewerage.
Construction and arrangement of gas-works ; detailed plans for the distribution of gas in towns ; condensers, purifiers, &c.
9th Section.—Special constructions :—
Plans and models of public buildings in large towns ; as markets, town-halls, abattoirs, granaries, &c.
Plans and models of private houses, presented as improved specimens in the art of construction.
Plans and models of houses for the working classes, presented as improvements in this kind of construction, chiefly as regards convenience, health, and economy.
Plans and models of buildings of various kinds, presented as improvements in the art of erecting warehouses, factories, and farm buildings.

EXTENT OF SPACE, AND SUBDIVISION AMONG THE DIFFERENT NATIONS.

We gave in our last Number some general particulars on this subject; but we are now able, from the official information published by the Imperial Commission, to give some details of a more accurate nature.

The whole of the space covered in for the exhibition of industrial or manufacturing products, entirely exclusive of the Palace of the Beaux Arts, is rather more than 19 English acres, and is made up as follows :—

The principal palace, or stone building, occupies...	8·10	acres.
The avenue or long gallery, with the building which contains the boilers	8·36	„
Junction or connecting gallery, and side-boards for refreshments	2·24	„
Buildings containing carriages and agricultural implements, &c.	·49	„
Total space covered on the ground-floor ...	19·19	„
In order, however, to obtain the whole space available for exhibition, we must add to this the area of the raised galleries in the principal building	5·53	acres.
And that of the two raised galleries in the Annexe......	1·94	„
Total	26·66	„

or nearly 27 acres of space.

The Great Exhibition of 1851 in Hyde Park contained on the ground-floor and galleries, in all, about 23½ acres; so that the covered space of the French Exhibition is somewhat larger.

Besides the covered area, there is an open space of more than 5½ acres enclosed on one side of the Palace, in which are placed objects of a size too large for exhibition within the walls.

The whole of the covered space actually devoted to the display of manufactures within the Palais de l'Industrie, the Annexe, and the Junction, including the upper galleries, is upwards of 111,900 square yards, which is thus appropriated :—

	English sq. yards.
France	55,042
England	19,320
States of Germanic Confederation	10,660
Austria	7,118
Belgium	5,472
Switzerland	2,191
United States of America	3,448
Holland	1,188
Turkey	691
Denmark	656
Egypt	730
Spain	588
Roman States	565
Sardinia	813
Portugal	533
Sweden and Norway	786
Tuscany	673
Tunis	353
Hanseatic Towns	295
Greece	223
States of South America	554

The whole number of exhibitors whose names appear in the Official Catalogue is 16,944, of whom 8,968 belong to France and her colonies, and the remaining 7,976 to foreign states. It appears, however, that many of the descriptions have been received from the exhibitors at too late a period for insertion in the Catalogue. When all these insertions are made in a second edition of the Catalogue, the number of French exhibitors will be increased by about 700, and the foreign exhibitors by upwards of 900 ; the total number of foreign exhibitors who have sent in descriptions of their articles being 8,742 to the 12th of May, 1855.

The French have had periodical expositions of their own national manufactures ever since 1806; and these have taken place quinquennially, or at intervals of five years, since 1834. In the natural order of time, therefore, the National Exposition would have happened in 1854 ; but this confined and especial exposition of French manufactures has been changed by a decree of the Emperor into a Universal Exposition, which was fixed for opening on the 1st of May, 1855, instead of the 1st of May, 1854, which would have been the proper day of opening for the quinquennial exposition.

A FEW PRACTICAL OBSERVATIONS ON THE MEANS EMPLOYED FOR TAKING THE END-THRUST OF SCREW-SHAFTS.

The subject of thrust in screw-ships has been one on which no little ingenuity has been displayed. Practical experience, however, has very much simplified and improved the earlier efforts in this direction.

The object of these contrivances is to prevent the tendency to wear on the after end or one side of the bearings for screw-propeller shafts, affecting the correct position of the crank-shaft bearing, and so affecting the direct action of the various working parts of the marine engine immediately in connexion therewith, as it would thereby throw an undue strain on and produce a rapid wearing of those parts. This is more particularly the case in engines working at a high velocity, and acting directly upon the screw-shaft.

Where multiple gearing is employed, and the screw-shaft having the pinion close to its inboard extremity, and working on a line parallel to but below the crank-shaft, as in the engines of the *Candia* by Rennie and Sons, and other screw-engines we have illustrated in The Artizan,—in such instances the effect of the end-thrust is not so injurious to the engines, as a good abutment can be given to the end of the shaft, with a suitable arrangement for adjustment, according to the amount of wear. But even in such cases as these, the arrangements, which we propose to describe, by which the wear is prevented acting injuriously, may be advantageously applied, whether motion be given to the screw-shaft through intermediate gearing, or otherwise; and it is rather the desideratum to attain a simple mechanical arrangement by which this can be effected, and the wearing parts replaced with facility: for it must be remembered that the case is very different to that of disconnecting a mill-shaft, and raising it out of its bearings, for the purpose of putting in liners or packing up its bearings. The propelling shafts in screw-ships being below the water-line, renders it at all times difficult to effect anything in the way of adjustment to the bearings or shaft; and the easier such matters can be performed, the greater advantage results in case of wear or accident.

We propose to illustrate the three principal plans now used by our best-known engine-makers, and conclude with a few practical observations thereon.

Figs. 1, 2, 3, and 4 are illustrations of an arrangement which we have named the "friction cone roller thrust."

Fig. 1 is an elevation (looking aft), with the cones in their places. The plate marked A is keyed on the screw-shaft; the rollers B, B, B, B, are kept in their position by two half-hoops, marked C, having four small spindles radiating therefrom at right angles to each other. On these spindles the rollers revolve, each roller being bushed with brass.

Fig. 2 is a longitudinal section, and

Fig. 3 is a plan of this arrangement at work. The plate D in Figs. 2 and 3 is shown separately in Fig. 4, and is a fixed part of the engine (often a solid casting, which is very objectionable).

The plate A, revolving with the shaft, presses on the friction cones B, carries them round, and the thrust is thus received by the fixed plate D.

We have not any very serious objections to offer to this plan ; but it does not appear to us well adapted for the wear and tear of a screw-engine, especially when used for engines of large power. It occurs to us, that if water were to get into the axles of the cones, and they should *set fast* (not an unlikely occurrence), the first dozen revolutions would *score* the rubbing surfaces past all remedy; and these cannot be easily repaired or replaced ; and, in our opinion, the plan is too much in the tool or machine maker style to be found thoroughly good in practice.

Figs. 5, 6, 7, and 8 are illustrations of the plan which has been almost universally used both in the royal and mercantile navy: it is called the "collar thrust bearing ;" but we have made some important alterations in the details, which we now explain.

Our sketches show this block as it *should be*, not as it is generally fitted. We have shown it with a bottom fixed plate, and a wood-liner under the pedestal, with joggles and adjustable keys for end and side adjustment. We need hardly say that a cheaper arrangement is generally used in practice, dispensing with the bottom plate, and sometimes the lower brass. Where the surfaces are not ample, and where dirt gets into the brasses, or from want of lubrication the brasses are worn and have to be renewed or relined with soft metal, it becomes a very serious matter to effect the necessary repairs to this thrust arrangement. We have known a case where two lengths of shafts had to be lifted out twice in *three months* to *reline* the lower brass with soft metal. This, we need hardly say, is a matter for grave consideration on the part of the engine-builders. The plan just described, which was patented in 1846, has been very extensively used, and we understand that the patentee is taking steps to ascertain to what extent it has been used by engineers and others. At any rate, we know that he is operating in some way or other on the Admiralty; and in anticipation of any question of infringement, &c. arising out of this plan, Maudslay, Sons, and Field have adopted another thrust apparatus, which, as it is in our opinion infinitely superior to any now in use, will, we are sure, be hailed by sea-going engineers, and by all who have the repairing of screw machinery, as a most important improvement.

Fig. 5 is a plan.

Fig. 6 is an elevation.

Fig. 7 is a longitudinal section; and

Fig 8, a cross section of the collar thrust pedestal.

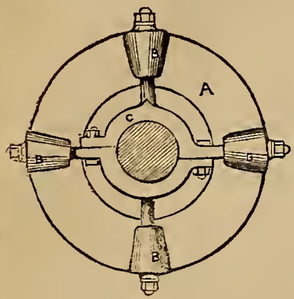


Fig. 1.

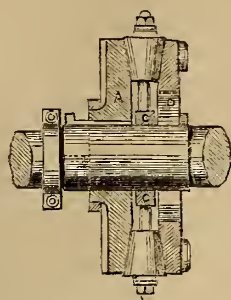


Fig. 2.

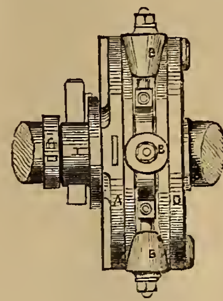


Fig. 3.

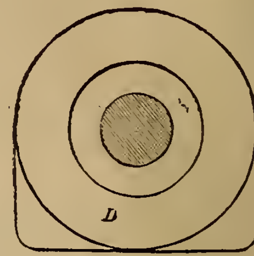


Fig. 4.

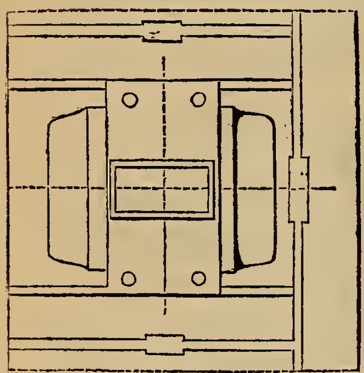


Fig. 5.

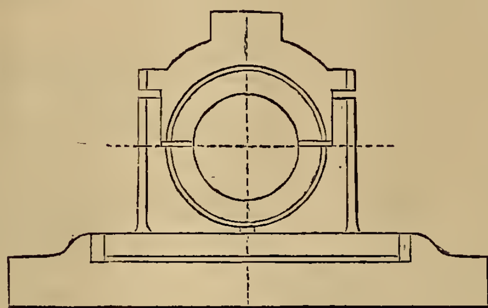


Fig. 6.

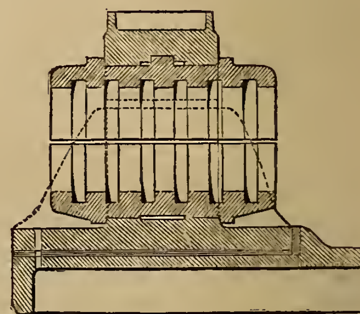


Fig. 7.

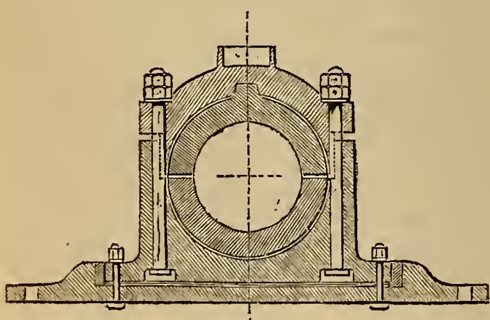


Fig. 8.

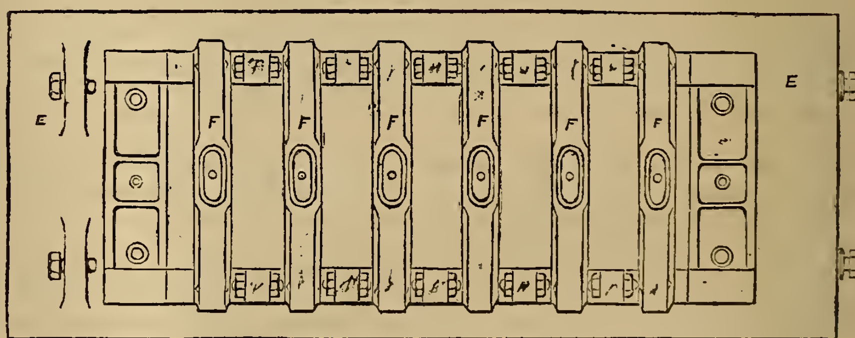


Fig. 9.

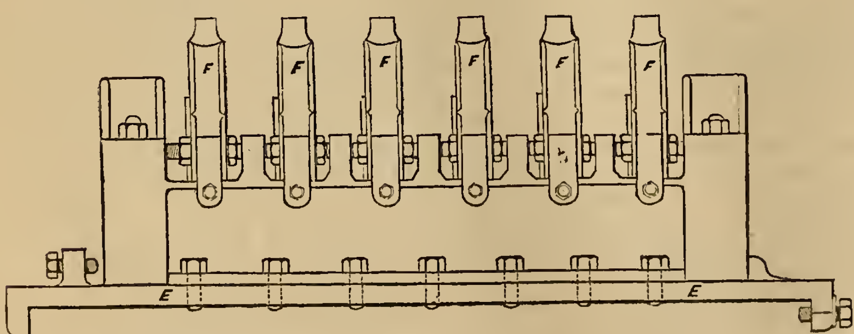


Fig. 11.

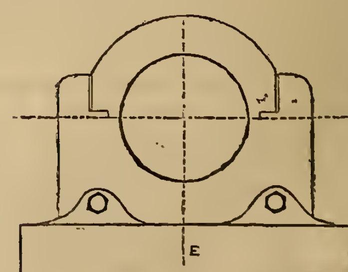


Fig. 12.

We have been favoured by a mechanical friend with sketches of the *Marlborough's* thrust-block, of 800 horse-power, as it lay on the wharf at Woolwich ready for shipment to Portsmouth.

Fig. 9 is a plan.

Fig. 10 is a longitudinal section.

Fig. 11 is an elevation.

Fig. 12 is an end view.

Fig. 13 is a sectional end view.

Fig. 14 shows the collars on the shaft.

It will be observed that the block is adjustable endways on the bottom plate E. (We would suggest a half-inch liner of oak between.)

The chief peculiarity of this thrust-block is its extreme simplicity. The frictional or wearing parts consist of six semicircular pieces, marked F, F. Each of these pieces is lined with soft metal, as shown between the lines K, K, on Fig. 13. These pieces are adjustable fore and aft *separately*; and in case of one or more of the pieces marked requiring to be taken out and replaced, this can be done without touching the shafting or any other part of the machinery.

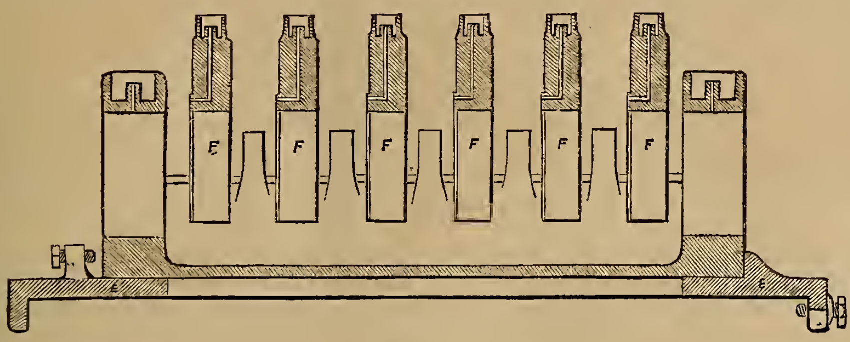


Fig. 10.

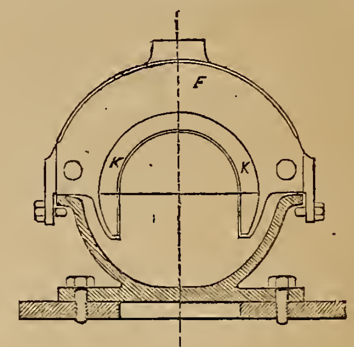


Fig. 13.

L, L, L, are oil-ways for lubricating the wearing surfaces.

Fig. 14.

We have often regretted that so little attention has been paid in *marine constructions*, even by some of our manufacturers of good standing, to the question of future repairs, by giving facilities for ready access to the working parts, and providing for adjustment in cases of wear and reinstatement in cases of accident at sea.

Who amongst us, as practical men, have not been placed occasionally in positions of mechanical difficulty, and felt the consequence of not providing originally for probable occurrences—provisions which could easily enough have been made in the construction of the machine? and although experience, as a school, does give us the most practical teachings, not alone is it said to be a costly mode of acquiring knowledge; but if those teachings are neglected or disregarded, then indeed that which is always said to be costly becomes doubly so, because that which has been acquired has not been profitably employed.

The contract system has some disadvantages, amongst which is its effect in causing disregard, by our most eminent engineers and contractors, to the question of the cost of future repairs.

With reference to machinery, when out of the contractor's hands, we fear the same feeling operates that provided the reply ascribed to an Hibernian,—"Pray, sir, what has posterity ever done for me?"

We may recur to this subject.

THE "WYE" STEAM-CONDENSING SHIP.

Having seen repeatedly, during the last few months, amongst the notices of the movements of ships at Portsmouth, mention made of a vessel named the *Wye*, which was described as being fitted out as a condensing vessel for making fresh water for our army in the Crimea, and this being the first attempt on a large scale to turn our scientific resources in this way to practical account, we were anxious to see the vessel and its fittings, and so judge for ourselves of the manner in which this simple but important object had been carried into effect. So, one day in the last week of August, we made our escape from the din, smoke, and bustle of London, and after a three hours' very pleasant ride on the South-Western Railway, we found ourself in H.M. Dockyard at Portsmouth. There, everything was activity—the yard swarmed with men, and the various departments were fully employed in connexion with the important struggle now actively going on between the Allied Powers and their less civilised but powerful enemy.

Taking advantage of an introduction to one of the officers of the *Wye*, we presented ourself, and were obligingly permitted by him to inspect the vessel, its machinery and arrangements, minutely.

The subject of the condensation of steam is well understood practically by steam engineers of the present day, more particularly marine engineers. Hall's patent condensers are also well understood by most of our readers; and various contrivances for the distillation of water—the condensation of steam produced from salt water—on a small scale, in cooking galleys, have formed the subject of several patents, and much ingenuity has been expended thereon. We have from time to time noticed in The Artizan such of these inventions as we considered the most practically useful. We felt that, as there was some novelty and much utility in connexion with the present application of the principle, we wished that we could have obtained permission from the proper authorities to have sent one of our draughtsmen to take sketches, so as to have illustrated the present subject by a suitable plate; but as public Boards generally do business at a pace too slow for our purposes, and some of the departments of Government are too prone to throw obstacles in the way of our obtaining practical information of this kind, we determined to rely upon our own ability, to carry away, "in our mind's eye," for the benefit of our readers, the general arrangement of the condensing apparatus of the *Wye*, and the illustration which accompanies this notice may be accepted as a pretty faithful sketch; but the minor details in the illustration cannot be vouched for: the Figures, however—such as the heating surfaces of the boiler, and the cooling surfaces of the condensers—are facts which we *can* vouch for.

The *Wye* is a vessel built of iron, by Messrs. Tulloch and Denny, of Dumbarton. She is of 672 tons, O.M., and was intended for the North of Europe Steam Navigation Company. The engines were made by the same firm, and are of 100 horse-power, of the direct-action construction, with the cylinders over the screw-shaft, intended to work at 43 revolutions, driving a three-bladed screw, of 12 feet diameter and 19 feet pitch. She has an elegant saloon, and numerous berths conveniently and tastefully fitted up. On the whole, her cabin accommodation partakes more of the character of a gentleman's steam-yacht.

The apparatus, as fitted on board the *Wye*, for distilling fresh water from the salt water used in the steam-engine boilers, consists of eight condensers, constructed according to Hall's patent—four on the starboard side and four on the port side of the vessel.

To those unacquainted with the form and construction of Hall's condensers, we may describe those used on board the *Wye* as consisting of a series of eight oblong boxes, each containing a number of tubes, 1 inch diameter in the bore, and 3 feet 7 inches long, fixed vertically.

The steam is admitted into a chamber above these tubes, and fills them, whilst the cold sea-water is freely admitted at the lower part of the box, surrounding the tubes, and circulating throughout the chamber in which the tubes are placed. It absorbs the heat from the steam contained within the tubes, and so being increased in temperature in a corresponding degree, becomes lighter, rises to the top, and escapes therefrom by an outlet pipe, giving place to a fresh supply of cold sea-water, which in turn performs a similar part.*

The steam is, as we have already stated, generated in the engine-boiler. The boiler of the *Wye* has a total fire-grate surface of 85 square feet, and 1,802 square feet of heating surface.

The total area of the condensing surfaces in the eight condensers is 936 square feet. And it will be observed, by reference to the illustration, that the distilled water, as it is condeused or comes over, runs into a large tank or reservoir in the bottom of the ship's hold below the level of the condensers. The water is, by means of a donkey engine, pumped from this reservoir tank into the stone tanks running along the middle of the floor of the fore-hold, or into tanks in the after-hold, or on deck, as may be required.

Having thus sketched, we hope sufficiently intelligibly, the arrangement of the vessel and apparatus, we cannot proceed without pausing here to make a few remarks relative to the fitting out of this ship with this novel apparatus, and the manner in which this affair has been conducted; and although we have no desire to indulge in a spirit of fault-finding, nor in making sweeping general charges of mismauagement against the Executive Government—for we leave such matters ordinarily to the leading political newspapers, and to our many able politicians and public men—still, on learning the history of this vessel, and the manner in which her conversion has been managed, we do most honestly protest, in the name of the large class of scientific men which we, as journalists, have the honour to represent, that this vessel and its fitment, which should have been a credit to English engineering, and a fair sample of modern practical science, and of the vast resources of our naval dockyards, are no doubt worthy of the Comptroller of the Victualling Department of the Navy, under whose direction the whole affair has been performed. But as an effort of engineering of the present day, it is a miserable abortion; for at a time when the utmost exertions are called for, the greatest promptitude required, and the best skill and talent should be consulted in connexion with all matters affecting the well-being of our troops, and the strengthening of the hands of the Government and those occupied in the administration of the war, it is not pleasing to hear the history of this piece of amateur engineering. The ship was brought to Portsmouth in the first week of the month of June. We saw her off Cowes the 1st of September, and she is reported to have been lying at Spithead in the first week in September, awaiting additional fittings. As we have said, the designing and construction of the condensers, and their application on board the *Wye* in connexion with the steam-boiler of that vessel, has been by the Comptroller of the Victualling Department at Somerset House, the works being executed on the spot, under the superintendence of a subordinate workman, and not formed in any manner in connexion with the Chief Engineer of Portsmouth Dockyard, or the steam authorities of the Admiralty.

Notwithstanding that nearly all the screw-ships in the navy have during the last few years been fitted with Hall's condensers attached to their steam-boiler, and the facts relating to the cooling or condensing surfaces have been carefully noted, and proper data obtained for dealing successfully with questions of this kind, to such an extent has the fitting out of this ship, the *Wye*, been a matter of trial and blunders with this clerical engineer, that the first trial of the condensing power of the apparatus was made in a dry dock filled with water for the occasion; but the limited quantity of water in the dock was soon heated, and the condensing process, much to the astonishment of the Comptroller, was in a very short time brought to a dead stop. But, with a view to remedy this, and ascertain whether Nature would lend her assistance and prove more propitious, the ship was loaded with many tons of pig ballast to bring her down in the water; and when she was taken out of the *steaming* dock into running water, the trial did give more cheering results to the presiding engiueer.

Subsequently many trials have been made, and the result is that it has been *discovered* the boiler can generate steam to produce 35,000 gallons of water in twenty-four hours; but the condensing surface of the eight condensers is equal to auother steam-boiler of nearly the same size.

Now, we found in the fore-hold space unoccupied sufficient for another boiler, and upon inquiry our informaut replied, somewhat gloomily, "I believe it is inteuded by the Comptroller to buy auother boiler somewhere, and send it out to the Crimea after us, so that we may fit it there at our leisure."

Now, from where we stood on the poop of the *Wye*, we counted at least sixteen pieces of new marine boilers, apparently awaiting the arrival of steam-ships with disabled boilers; and knowing, as we do, the great resources of the steam-factories of Woolwich aud Portsmouth, we have no hesitation in asserting that one of these pieces could have been fitted in less than ten days. Yet the existence of these boilers does not seem to have been known to the Comptroller; nor do the capabilities for producing a suitable boiler, and fitting it on board by the factory departmeut, appear to be understood by him.

Why the Surveyor of the Navy should have allowed this work quietly to proceed as far and for so loug a time, we cannot imagine, unless indeed it be that his duties are so numerous and onerous that he has been kept ignorant of the facts. But the country has not yet forgotten the vast sums of money expeuded in amateur ship-building; and as the Surveyor of the Navy is the head of the mechanical department of our dockyard works, and knowing, or should know, their resources, and the professional ability of the mechanical officers employed, we ask, in the name of common sense, why this important and novel engineering undertaking should have been taken out of its legitimate channel and committed to the superintendence of the chief of a clerical branch of the Admiralty; remembering that if the officer referred to can find sufficient time to devote to other pursuits than his own department, it would be well to suggest that such time might be more satisfactorily employed in properly organising the various departments under his control, puttiug them in better working order, and effecting a harmony whieh would be productive of a great good. It was all very well for this gentleman in the "piping times of peace," aud whilst storekeeper at Gosport Victualling-yard, to carry out at the country's expense his scientific crotchets; but the urgent wants of the present times, and the expressed wishes of the nation, are too important and too grave to tolerate, without remonstration on our part, such scientific trifling and pecuniary waste.

It would be well for some of the Administrative Reform Members of Parliament to ask of the Government, why it is that, having so many vessels of large tonnage lying rotting at Sheerness, Portsmouth, and Plymouth, a small vessel of 600 tons burden, fitted in every respect most elegantly for passenger traffic, and quite new, should have been purchased by the Admiralty for £24,000, that she might be converted, at a vast additional expense, into a small floating water-tank? If this is not a *job*, it is, at least, a slovenly and indiscreet waste of public money.

One parting sentence, and we take leave of the *Wye*. We would remind the Admiralty that they are, in that vessel, using an apparatus which they have found of great value to the public service: we mean "Hall's condenser." It cannot be denied that mechanical science is much indebted to Mr. Hall for many contributions to the general fund; aud we feel assured that we are expressing the feelings of our profession generally

* We would feel obliged if some of our engineering friends would communicate with us as to whom, in their opinion, the public really is indebted originally for the practical application of Nature's laws in the manner described as to the arrangements of condensers. We would also advise our engineering friends who superintend the *fitting out* of the numerous steam-ships built in order to be employed for carrying passengers, to copy the arrangements just described, instead of *pumping* the condensing water, as is now more generally done.

when we say that a suitable grant of public money to that gentleman would be a graceful and proper acknowledgment of his public services, and more appropriate and more merited than some other grants which have been made.

PRACTICAL PAPERS.—No. VI.

ON DESIGNING MARINE WORK.

If lifting-gear be used, it may be arranged as in H.M. steam-ship *Wasp*, by Miller, Ravenhill, and Co.; in which case the propeller-shaft is withdrawn inboard from the boss. To render this operation of disconnecting simple, we proposed some time ago, in the course of ordinary business, to insert a short length of cast-iron between the propeller-shaft and the length next to it, which was to be removed when the propeller was lifted. In our last number, a correspondent favoured us with a sketch of a distance-piece, which differs in some respects from the plan which we shall now describe. It was proposed to construct a cylindrical block of cast-iron of such a length, that when removed, the shafts could be drawn together, so that the end length might clear the propeller-boss or short supporting-shaft borne by the lifting-frame. A link was to be suspended from an eye-bolt in the tunnel, having a strap formed on the lower extremity, to pass round the distance-piece, to facilitate its removal or replacement. The operation of disconnecting the shafts and drawing the end length in would be thus effected. The bolts would be removed, and the block hung by the link from the centre of the tunnel would be easily slung on one side—a recess, if necessary, being formed to receive it in the side of the tunnel. Here it could be secured, and the shaft drawn through the stern-pipe by a couple of bolts screwed their entire length for the purpose. To connect the propeller again, it would be necessary to force the shaft out by providing a suitable shackle and eye-bolts in the bulkhead: the distance-piece would then be guided accurately into its place by the radius link, and the bolts reinserted. Irrespectively of these considerations, there is a practical difficulty in fitting the shafts into the boat, arising from inaccuracies of workmanship, which the distance-piece would be of service in removing. This arises from the fact, that the supports or bearers for the pedestals for the shafts are seldom placed exactly according to the dimensions shown on the "shafting-piece" as to length on line of keel. These dimensions will nearly always be found sufficiently adhered to, to enable the engineer to turn the propeller-shaft, the pinion-shaft, and the intermediate lengths except one, the order for the forging of which may be judiciously delayed till the construction of the ship is so far advanced that "staffs" can be laid on the pedestal supports, and their actual position ascertained. But this operation is liable to error; and when a vessel is fitted with lifting-gear, or an outside bearing and friction plate on the rudder-post, the thrust-bearing being supposed next the pinion-shaft, it is necessary that the distance be obtained within a quarter of an inch. Our practical readers know, doubtless, that a quarter of an inch is easily lost or gained in such an operation, if the vessel is of any considerable size: to wait till all but the last length of shafting were laid, and then to order it, might delay inconveniently the final completion of the machinery. The advantage of using the distance-piece in this case is, then, that it could probably be made and fitted in as many days as the shaft would take weeks to forge and turn; and the measurements, taken with ordinary care, would always warrant the completion of the "line" up to this point. With extraordinary care, especially with flanged couplings, the engineer may congratulate himself if his workmen happen to adjust the shafts correctly by the first measurements.

In concluding our remarks at present upon the "shafting plan," we may add, that it is very customary to fit a friction-hoop or brake on the forward coupling of the thrust-bearing shaft, to prevent the action of a "sea" on the propeller, baffling the endeavours of the engineers to connect the shafts; and, also, it is now considered requisite in all engines of considerable power to provide means for turning them by hand. Both of these objects may be variously and easily effected; but the position of the means of doing so should be now fixed, in order to provide for them, if necessary, in the tunnel.

In first-class steamers, the welcome addition of lamps, permanently fixed and lighted, has been made to the fittings of the tunnels; and as they required fresh air as well as the engineers, so ventilating pipes are provided: and as fresh air, perhaps, would increase the annoyance of a broken head, and render the men more active in looking after the "bearings," so hand-railings are provided to aid them in this meritorious exertion. Finally, to complete the arrangements, gutta-percha tubing or other piping is laid throughout the tunnel, to diminish, as much as possible, the effects, that the best workmanship cannot at all times prevent, of the bearings becoming hot.

IMPROVED MOULDING MACHINE.

(Illustrated by Plate lvii.)

In The Artizan for May, 1853, we noticed an excellent planing machine, designed and constructed by Messrs. Worssam and Co., Engineers, King's-road, Chelsea. Those machines have since been extensively manufactured, and have given the highest satisfaction to all who have used them.

We have now the pleasure of presenting to our readers another specimen of Messrs. Worssam's skill in producing machines for the economical working of wood, which is illustrated by Plate lvii.

The present machine is a very compact, substantial and complete labour-saving apparatus, and will, we predict, be rapidly and generally adopted, not only in the joiner's shop, but for many purposes where machines for moulding or shaping wood have not hitherto been employed.

Our engraving represents a side view and elevation and plan of a machine just erected in the very extensive works of Messrs. C. W. Waterlow and Co., at Bearbinder's-lane, Old Ford. It has been worked much to their satisfaction; but we propose deferring until next month an account of its performance.

AMERICAN NOTES.—No. X.

Telephonic Signals for Marine Purposes.—The loss of the U.S. mail-steamer *Arctic* gave rise to many suggestions as to the adoption of a system of signals. The following communication upon this subject is now under the consideration of our Board of Underwriters:—

"Sir,—Having received and considered the communications of Professor D. H. Mahan, of the U.S. Military Academy, and of Lieut. W. S. Bartlett, U.S.N., regarding precautionary measures to be observed by steamers at sea when running in an obscured atmosphere, I have to present to your notice the following reply thereto, together with my own view as to the precautions to be observed in such cases.

"In the communication of Professor Mahan, it is proposed to resort to the use of blasts from a steam-whistle in systematic connexion with the vibrations of a gong, which indications being interpreted by reference to a key in possession of navigators, the position and course of a steamer may be readily ascertained; and in that of Lieut. Bartlett the same end is proposed to be obtained by blasts from a steam-whistle, peculiar to each of the cardinal points of the compass.

"Both of these systems are practicable, but objectionable in some of their features, and for the following reasons:—

"1st. That of Professor Mahan is unnecessarily complicated by the introduction of a gong, and the interval between the signals is so short as to render attention to them unceasing, whilst the frequent occurrence of them would be more objectionable of endurance to passengers and crew than the risk of collision.

"2nd. That of Lieut. Bartlett is the least objectionable of the two; but the number of the blasts is unnecessarily extended, and, therefore, liable to increase confusion and consequent error.

"A reference to the facts of the late loss of the U.S. mail-steamer *Arctic*, to the existing elements of precaution and the necessity for it to guard against like occurrences, presents the following details:—

"1st. The end desired to be attained is the increased security of lives and of property from the collision of steamers with each other and with sailing-vessels.

"2nd. The only practicable method that suggests itself is that of the navigators of steam-vessels to avail themselves of the very effective means of a steam-whistle—an instrument with which nearly all of our steamers are now supplied; and where it is not in use, the cost involved in its purchase and attachment is so inconsiderate, its utility considered, that it cannot present any objectionable feature to its adoption; and with sailing-vessels, where such an instrument is not available, the watch-bell can be resorted to.

"3rd. Signals are only necessary to guard navigators from the collision of their vessels, one with another, within a space of half a mile.

"4th. The highest speed yet attained by steam and sailing vessels at sea, or likely to be obtained by them *in an obscured atmosphere*, within many years, would not justify any assumption of a higher combined velocity to two vessels approaching each other upon opposite courses than that of 36 miles (knots) per hour: half a mile would therefore be made by them in the space of 50 seconds; and when the speed was altogether upon the part of one vessel, as in the cases of the sailing-vessel being becalmed, or the steamer crippled or disabled, the speed would not exceed 20 miles, and the time consumed then in running half a mile would be one minute and a half.

"The Board of Supervising Inspectors of Steam-vessels, appointed under the Act of Congress of 30th August, 1852, have ordered that the pilots of all steam-vessels navigating seas, gulfs, bays, lakes, or rivers of the United States, when their vessels are running in a fog, 'shall cause a bell to be struck or the steam-whistle to be sounded every two minutes.' No provisions are here required from navigators, as a precaution from collision, when their vessels are at anchor; and a critical construction of the regulation might, with those who were indisposed to practise the precaution required, furnish a justification for non-compliance with it when the atmosphere was obscured by snow, rain, or mist.

"Further, the regulation is confined only to the maritime jurisdiction of the United States.

"5th. The variations of time on board of all vessels would have the effect, in an average of cases, of reducing the intervals of time between the sounding of signals one-half.

"With these elements before me, then, I present the following regulations to be observed by navigators of steam and sailing vessels during the existence of an obscured atmosphere:—

"1st. All steam and sailing vessels to be provided with watch-bells; and all steamers to be further fitted with a steam-whistle of sufficient capacity to be heard, in calm weather, five miles.

"2nd. Navigators of steamers and sailing-vessels without the maritime jurisdiction of the United States, when running, lying to, or at anchor, to give one full stroke of their bell, or blast from their steam-whistle, as they may be provided and prepared, every five minutes; and when they shall hear either of these signals from another vessel, they shall immediately telephone their course or position after the following rules:—

"When running or heading between north-west and north-east, with one stroke of their bell or one blast of their steam-whistle; and when running, &c., as above, between north-east and south-east, with two distinct strokes or blasts; and when between south-east and south-west, three distinct strokes or blasts; and when between south-west and north-west, with four distinct strokes or blasts. And they shall continue these signals every two and one-half minutes, until they shall have passed beyond the risk of collision with each other.

"3rd. Navigators of steamers and sailing-vessels, when entering into a harbour, are to give two continuous strokes of their watch-bell, or blast from their steam-whistle, every five minutes.

"4th. When navigators of steamers and sailing-vessels have entered into a harbour, they are to conform to the maritime regulations of it; and when it is known that none exist, they are to be guided by the existing regulations of the United States as here given.

"5th. When it may be necessary, in the opinion of any one or both of the navigators of two vessels approaching each other, to know the courses of each other nearer than that provided for as above, as in the case of a vessel running upon an extreme of the range of eight points embraced in a signal, and another either upon the other extreme of the range of the same signal or upon the near extreme of the range of the signal contiguous to it, the navigator who desires to know the course of the other vessel approaching him to give his course as above directed, and immediately thereafter to give the signal of the course in the range nearest to his, in short and rapid strokes of his bell, or blasts from his whistle, as he may be provided to do; and the other is to reply in like manner, and to give the course in the range nearest to his. Thus, if the course of a vessel was between east and south-east, the signal would be two distinct strokes or blasts, and immediately thereafter three rapid strokes or blasts, signifying that her course, although within the range of north-east and south-east, approached to that of south-east.

"The utility of this system over that of one where the course of a vessel is being constantly indicated is, that it reduces the number of signals, and thereby removes from it the objectionable features of unnecessary labour to those in charge of the duty, and of unnecessary disturbance to the passengers and crew, whilst it retains the whole of the essential feature, that of the indications of the courses of vessels in proximity with each other.

"In the operation of this system, however, full success is neither claimed nor anticipated, neither is it conceded to any system depending alone on telephonic signals; for in order to meet some cases, of which the following are fair instances, a light of sufficient power to reflect its rays in a fog or mist at a distance of a quarter of a mile must be resorted to, and placed upon the bows of all vessels.

"The instances alluded to as such as would seem to render the precaution of even a steam-whistle inoperative are—

"1st. When a sailing-vessel is 'lying to' in heavy, thick weather, and a steamer approaches her on the course of her lee beam, the watch of the sailing-vessel may be unable both to hear aud see the steamer until she is too close upon them to be avoided in the inert condition of 'lying to;' and the watch of the steamer, unable either to see the sailing-vessel or to hear her watch-bell (it being of the usual size carried in vessels), they cannot discover their proximity to another vessel until it is too late, at their rate of speed, to avoid collision, they only under the immediate commaud of the helm.

"2nd. The times of two vessels being alike, their signals may be given identical in time and duration; and if approaching each other at a high velocity, collision would be difficult of avoidance.

"3rd. The steam-whistle of a steamer may become temporarily inoperative from a fracture of its pipe or other cause, and the watches of one or both vessels may neglect a signal.

"I am of the opinion, therefore, that no system of signals adapted to an obscured atmosphere at sea can be always reliable without the introduction of a light of great power placed so as to be seen only from ahead of the vessel carrying it; and in connexion with this view of the requirements of navigation, I am gratified at being able to advise you that a light designed to meet this purpose has just been brought to my notice, and that it is one holding forth much promise of its practicability.

"I am respectfully, your obedient servant,
"Chas. H. Haswell, Surveyor.

"To Walter R. Jones, Esq.,
"President Board of Underwriters,
"New York."

Burning Coal Mountain.—That remarkable phenomenon in uatural science, the coal mountain in Pennsylvania, which has been on fire since 1837, will soon be extinguished, as the fire is approaching a point which can be submerged in water. A mass of coal has been consumed three-eighths of a mile long, 60 feet wide, 300 deep, and equal to 1,420,000 tons of coal.

Artesian Well in Alabama.—A few days ago, quite a curiosity was brought up from the bottom of the Artesian well in Livingston, Ala. At a distance of 335 feet below the surface, and over 300 feet iu the rock, an egg was found completely petrified and perfect in shape, save where the auger had defaced it a little.

Precipitation of Metals from the Human System by Galvanism.—Metals have been extracted from the human system by an electric current, the patient being seated in a bath during the operation. The editor of the "Columbus (Ohio) Journal" also states, that he lately witnessed this operation successfully performed on Jacob Hymrod, of this place, by Drs. Youman and Seltzer; but he describes the operation so unscientifically, that we must say the effects could not be produced *as he has described them.* The first, to our knowledge, who applied the galvanic fluid to extract metals from the human system, was Professor Vergenes, of this city, whose electro-magnetic engine was illustrated on page 184, vol. ix., "Scientific American," and who has contributed some very profound articles on electro-magnetism to our columns. He extracted silver from his own system by the galvanic pile in 1852, he having seriously injured his hands by the use of the nitrate of silver in gilding by the electrotype process.—*Scientific American.*

Uni Fence.—The "Plow, Loom, and Anvil" speaks of a machine being invented by J. Nesbitt, of Lowell, Mass., which can make netting wire fence at from 75 cents to 2 dollars per rod. At such prices, this fence, if good, should meet with a most extensive sale.—*Ibid.*

Charleston Artesian Well.—This well, the deepest in our country, which continued for some time to pour out its water at the rate of 30 gallons per minute, has ceased flowing. Whether the underground supply has fallen short, or something has choked up the bore, we have not yet heard.—*Ibid.*

Tunnel under the Niagara River.—It is proposed to dig a tuunel for a railroad track under the Niagara River, at Black Rock, near Buffalo, New York. Its length will be 2,400 feet; descent of grade on each side, 75 feet per mile; cost, 500,000 dols. The river is 20 feet deep at the proposed locality, and its bed of solid limestone.—*Ibid.*

New York. H.

NOTES BY A PRACTICAL CHEMIST.

Improved Marking Ink.—Mix 11 parts (by weight) nitrate of silver, 22 of liquid ammonia, 22 crystalline carbonate of soda, 50 of gum-arabic, 2 of sap-green, and 13 of distilled water. The linen printed must be exposed to the sun, or pressed with a hot iron until the letters no longer increase in blackness.

Constitution of Ozone.—This substance, which has been attracting so much attention for a number of years, and which is found capable of various practical applications, after careful examination is found not to be a peroxide of hydrogen or any compound, but merely an allotropic variety of oxygen.

Note on the Assaying of Silver by the Moist Way.—We meet occasionally with auriferous specimens of silver containing tin, which, when treated with nitric acid, produce the purple of Cassius. This matter remains for a long time suspended, and cannot be removed without filtration—a process which occasions delay and some uncertainty. The difficulty may be obviated by using concentrated sulphuric acid in place of nitric. In making an essay, Levol uses about 25 grammes of the acid, boils for several minutes, suffers it to cool a little, and then proceeds as usual.

Valuation of Bleaching Powders.—Noelluer proposes the following process:—One grm. of the sample of chloride of lime is mixed with two grms. of hyposulphite of soda and water, in a flask of such size that, when stoppered, there shall be room for the complete diffusion of the chloride of lime by shaking. The complete conversion of the hyposulphite into sulphate takes place even in the cold; but, for greater certainty, the flask is slightly heated in the water-bath. It is then mixed with pure muriatic acid, to decompose all the excess of hyposulphite. By inclining the flask and boiling, all the sulphurous acid is expelled, and the sulphur is deposited in drops. The liquid is filtered off, and the filter washed. The clear solution is now precipitated with chloride of barium. As 16 parts of sulphur require 8 of oxygen to form hyposulphurous acid, and the same 16 of sulphur must take up twice 8 of oxygen to form sulphuric acid; then, for every 2 equivs. of chlorine, 1 equiv. sulphate of baryta will be found, 116·5 parts or 1 equiv. sulphate of baryta representing 71·5 parts or 2 equivs. chlorine. The hyposulphite has the advantage of occurring pure in commerce.

ANSWERS TO CORRESPONDENTS.

"G. P."—The soluble sulphurets may be detected by the nitro-prusside of potassium or sodium, which strikes a beautiful purple.

"Mordax."—Iron is not poisouous—a property which, to the best of our knowledge, attaches to all the remaining heavy metals and their compounds.

"A Querist."—The vegetable colouring matters are, as a rule, precipitated along with metallic sesquioxides, alumina, oxide of tin, sesquioxides of iron, chrome, and antimony. The precipitates are called *lakes*.

"S. R."—Forward the sample, and it shall be analysed at our earliest convenience.

REVIEWS AND NOTICES OF BOOKS.

Muspratt's Chemistry applied to Arts and Manufactures. (Third notice.)

This valuable work progresses very satisfactorily, although how, on its present scale, it can be completed in thirty-six parts, is rather doubtful.

The article on bread is most elaborate. We have comparative analyses of the different parts of the grain, showing the great loss of nutritive matter involved in the present process of grinding, that portion which adheres to the husk being most nitrogenous. When will the public learn to disregard colour in articles of food, and prefer bread made from the entire grain, not from its least nutritious portion? Next follows a review of the remaining cereals, commencing with rye, the food of Germany, which, when affected with the disease called *ergot*, assumes poisonous properties. Indian corn is distinguished from other cereals by its excess of oil (4½ per cent.), and rice by its large amount of water (13½ per cent.), and remarkably little fatty matter. The former occasions, whilst the latter often remedies, diarrhœa. The various processes used in winnowing, sifting, and grinding coru are next carefully described —a digression, in our opinion, somewhat questionable, since the considerations here involved are purely mechanical, not chemical.

The fabrication of bread and the process of fermentation are luminously explained. When water is added to the flour, a proportion of the starch is converted under the influence of the gluteu into sugar, which again in contact with the yeast is decomposed into carbonic acid and alcohol, both volatile. A trace of acetic acid is likewise generated, if the action be prolonged. The various baking powders designed to supersede yeast have all, it is remarked. proved failures. It was supposed, that as the action of carbonic acid is merely mechanical, giving a cellular structure to the bread, this gas might be generated more economically than by decomposing a part of the flour. But the bread prepared with these various substitutes is "raised" irregularly, the development of carbonic acid commencing before the whole mass has been equally and thoroughly incorporated. Hence some parts of the loaf are full of large holes, whilst in others the dough remains dense and compact. The German barm now so extensively used is obtained from the fermentation of a mixture of rye and malt. The grain employed is often unfortunately of a very inferior quality, even diseased rye being employed, which in some instances has led to serious results. It is remarkable that its fermentative power may be easily destroyed by concussion, as by letting the packages fall.

The various adulterations of bread are investigated in a very searching manner, and tests for the various impurities, capable of being applied by unprofessional hands, are laid down. In the article on milk, placed as an appendix under the head "Butter," we have reference to its use in calico-printing. Vegetable fibre, coated with albumen or caseine, takes up colours with the brilliance formerly thought peculiar to silk. As an addition to olive oil, milk is now also largely employed in the woollen trade. The preparation of butter and the mechanism of churns are described at great length. The amount of water present in this common article of diet sometimes constitutes one-fourth, or even one-third. The important manufacture of candles comes next under consideration. This branch of trade does not date further back than the second or third century—the "candles" spoken of in more ancient authors being either lamps or torches, strings of flax coated with wax or pitch. The various kinds of fats and oils are described, with the methods used in their extraction and purification. Wax, it is stated, is elaborated not only by bees, but by another insect, *Coccus cerifcrus*, and by the berries of several plants. It is bleached in France either by exposing it in thin laminæ to the action of the sun and wind, or by melting it along with bitartrate of potash suspended in water.

Ingenhohl melts the wax, adding to every pound-weight 2 oz. powdered nitrate of soda and 1 oz. strong sulphuric acid, previously diluted with 8 oz. water. The liquid is poured in warm, and continually stirred. The vessel should be large. It is repeatedly treated with boiling water until all sulphate of soda and nitric acid are removed. Paraffine, originally extracted from beech-tar, is now prepared from bituminous schists, and proves to be a beautiful illuminating substance.

The utility of hog's lard in the candle manufacture depends, we are told, on the food of the animal. If this be grain or potatoes, the lard is firm and white; but if distillers' wash be used, the fat is yellow and oily.

It is of great importance that tallow should be rendered or purified immediately after the death of the animal. If allowed to lie, it undergoes a kind of fermentation, by which its quality is much impaired.

We find also a careful notice of the various plans proposed for abating the nuisance produced by melting down tallows, since the fumes, if not in the strictest sense deleterious, are highly offensive. The addition of sulphuric acid, in the proportion of 4 oz. to a pint and a quarter of water for three pounds and a quarter of crude tallow, has been found an improvement.

(To be continued.)

The Isthmus of Suez Question. By Mons. Ferdinand de Lesseps, Minister Plenipotentiary.—Paris: Galignani. London: Longman.

This book and its subject are both highly attractive,—the book from its cleverness, and the subject from its importance.

The subject, the uniting by a maritime canal the Mediterranean and the Red Seas, is matter not only of national interest, but of interest to all nations; and great is the pity that it should still remain, as M. Lesseps truly styles it, "A Question." So vast in its effects and prospects would be the opening the Isthmus of Suez for the transit of ships of all burthens, that it may be said to involve an operation worthy the title of a creation; for "if, when done, 'twere well done," it would be not only creating a *new sea*, though but a narrow one, but it would also render two existing seas immensely more useful to the human family than they have hitherto been. A main charm which we see in the consummation of that undertaking, is the sensible increase of facility it will afford for the rapid advancement of modern civilisation towards so many peoples who have for centuries suffered under the consequences of retrocession from the earlier civilisation their ancestors possessed; a sad and baneful depression on its victims, and one, a repetition of which will be assuredly spared to them, when increased intercourse with modern nations, their morals and habits, shall have re-awakened those nations to the blessings of revealed religion. In the way, however, of the progress of this important undertaking there have hitherto stood two difficulties: one, political jealousy; the other, pecuniary hesitation. We would fain hope that the time has now arrived when both the one and the other of those impediments may be overcome, as well as the physical difficulties of the undertaking.

We trust that the old-fashioned international jealousy may give way to a cosmopolitan and comprehensive policy amongst the leading nations of Europe, and induce a general compliance with the honest proprieties of the case.

The achieving effective and facile ship-transit through either of those —by nature, so curiously interposed—impediments, the two slips of land, the one of Suez, the other of Darien, will be so magnificent an operation, and one of so world-wide importance, that not only the anxious attention of all scientific and enterprising persons, but that of all civilised nations should be addressed to it. Their co-operation—that is, on terms which may be just to each other—should be cheerfully afforded to such scheme for its accomplishment as may be well conceived, well digested, and undertaken in a non-exclusive spirit.

Now that enlightenment has made so current, and success has made so palatable, Free Trade, surely everything, whether large or small, which may promote international communication should meet the countenance of international reciprocation.

In this spirit, therefore, it is that we should wish to see our rulers, even amidst their present belligerent anxieties, look with a favouring eye on a soundly-projected plan for the removal of those few yet difficult miles of impediment to rapid Oriental transit for heavy cargoes.

It is towards arresting the attention of that important section of our nation, the scientific, the technical, and the enterprising, that we feel bound to avail ourselves of the promising occasion of M. Lesseps' able revival of this very interesting subject, for inviting our readers' most reflective investigation of the question itself in its broad aspect of international interests, and in its more limited phase of the details of its feasibility;—if they shall arrive at the conclusion that this particular plan merits support, then that they rouse their countrymen to the taking a just participation in the undertaking. Such operations as this are worthy of being, and ought to be, the people's, as contradistinguished from governmental "*net-weaving*," and dynastic and bureaucratic protocolling; processes by which mankind have suffered too much already—processes which, although, with the persons their performers, hitherto allowed the lead amongst nations, are found to be too often but leaden clogs on advancement, rather than the luminous pioneers of progress. We challenge, therefore, our scientific and technical readers to think, and to communicate their thoughts, on this most interesting subject.

The accomplishment of the Suez undertaking would, no doubt, insure an early sequence of that of Darien. The cost of either, though large in figures, would, when borne or even aided by nations, whether from their state funds or credits, or from the joint-stock contributions of individuals amongst the various peoples, be of small amount. *Half* the expense of a single *half-year* of war would more than cover the expense of both operations, and would write in history, to the credit of this nineteenth century, the performance of that Grand Work which, in the Egyptian case, thirty centuries have been sighing for but doubting over.

Thus, it will be seen that promotion of the noble undertaking of the opening the Isthmus of Suez by a really effective ship-canal has our heartiest good wishes. Of M. Lesseps' book, and the proposition developed by it, we now proceed to speak.

Of the book, we have to say that it is a really brilliant specimen of the taste for and power of organisation possessed and effectively practised by so many of our generally talented and very ingenious neighbours. In this pamphlet, M. Lesseps has had the spirit and ability to combine both pencil and pen painting. By the former he shows us a coloured panoramic view, and a very effective one too, of the whole of the Isthmus of Suez, with the entire line of the proposed canal. He next presents a plan, chartlike and thoroughly intelligible, of the whole *locus in quo*, embracing the entire Isthmus, portions of the two seas, the Delta and something more of the Nile, with the proposed new cutting. He also, in contrast, shows clear delineations of the existing means of mixed land and water transit, and, finally, traces the positions of the former attempts at canalisation.

With his adroit and fluent pen, he concisely yet accurately describes the modern historical state of the question. He also presents, with all appearance, and we give him credit for intention also, of genuine candour, the various aspects of the international political views of the present and last century. He then, with much fairness, introduces the opinions of our able countrymen, Mr. Arthur Anderson and Captain Vetch.

He gives the Report—and a very comprehensive and masterly one it is—of the two engineers, his own countrymen, Linant Bey and Mougel Bey, both for many years in the employ of the Viceroy of Egypt, on Hydraulic Works.

The Plan of Canal proposed is a cutting running almost directly north (yet waving in its line) from the north-east corner of that portion of the Red Sea, or Gulf of Arabia, forming the Bay of Suez, to that point on the southern shore of the Mediterranean to which runs the easternmost angle of the Delta of the Nile. There the canal will issue by, and avail itself of, the harbour and bay of ancient Pelusium, formerly and for centuries the largest and most important port of Egypt, and reckoned its maritime key. Two important lakes—the one that of Timsch, the other that of the Bitter Lake—are passed through and made assistant to the canal; and a *tributary feeder* from a main stream of the Nile will be obtained by means of a former line of canal, which, even in its present state, will be easily convertible into that invaluable assistant.

Locks.—Of these there will be *but two*, both of gigantic dimensions, yet of comparatively easy construction.

The two termini, one in each sea, are, we are assured on the faith of most anxious investigation, much favoured by nature.

There is, too, *a sufficient fall* from the Red Sea to the Mediterranean, to afford to the undertaking the continuous and invaluable protection of *scourage*, and that susceptible of entire control.

The Dimensions of the canal will be—

Length	90 miles.
Mesne breadth	325 feet.
Depth	20 feet.

The Cost of the operation, when completed, is estimated at an amount within £7,000,000.

Many incidental matters are embraced by this scheme which, although but subsidiary to the main operation, are, many of them, in themselves not only of great ingenuity, but of much importance. Amongst them is a plan for *fixing* and controlling certain important sections of the *Desert by means of partial planting.* Such has already been successfully accomplished elsewhere in similar situations.

Statistical Calculations, showing the maritime and commercial advantages to ensue on the completion of this undertaking, are given clearly, and, apparently, faithfully.

The prospective Revenue, and the modes of its raising, are also shown. Thus we have traced the outlines of M. Lesseps' plans.

There is one other feature in the present position of this important question to which we advert with unfeigned pleasure: it is the enlightened conduct of the present Viceroy of Egypt, Said Pacha, to which we allude. The mention of this we have reserved to this latter part of our notice, in order that it might have the fuller weight with our readers when the perusal of the previous sketch shall have possessed them of M. Lesseps' plans.

This active-minded Prince does not confine himself to the exercise of sovereignty in the sense usual with Oriental rulers—viz., realising the advantages of tribute, and other sovereign conveniences. Said Pacha, on the contrary, has made himself master of the subject; he understands it thoroughly, and is desirous of being its active promoter. His early studies, and his experience in nautical art, have perfectly prepared him for the comprehension of all the bearings of the scientific question. The track followed by the projected line was of his own selection. It was pointed out by him because the shortest which could be rendered capable of affording transit for the largest ships, and as being, from its natural and existing qualities, the least expensive. It was he who indicated Pelusium and Suez as the extreme points of the cutting to be made through that narrow tract of land which, for 90 miles, presents a longitudinal depression across the Isthmus, and is formed by the meeting of the two plains, descending with a gradual slope—the one from Egypt, the other from the frontier hills of Asia. The Pacha says that Nature has herself traced out the communication, between the two seas, in the line of this depression.

The terms of the firman of concession were of his own dictation.

He also required than an attentive re-examination of the localities should be made, in order to profit by all the advantages offered by nature: and, finally, it is his anxious desire that the undertaking should be made thoroughly complete.

Under these circumstances, it seems, the Viceroy granted to M. Lesseps a firman or concession of the right of cutting such canal; *that firman, however, to be subject to the confirmation of the Viceroy's Imperial Sovereign, the Sultan of Turkey.*

M. Lesseps states that the concession was, on its grant, immediately communicated to the Consuls-General in Egypt of the European Powers, and first to the British Consul.

With this firman in his possession, M. Lesseps addresses himself to the people of the British nation for their concurrence and co-operation, —in short, for their aiding with pecuniary means the carrying it into effect.

It will, we think, be seen from the foregoing that our enterprising neighbour has our good wishes for the advancement of the noble undertaking to which he is addressing himself; but we also decidedly wish that our own countrymen should insure that, whilst they take interest in and afford support to the operation, they be effectively represented in the course and mode of its performance, and that this country's interest be amply protected in the advantages to be derived from the canal when completed.

Exciting anything like jealousy is the last thing we would do; but we think we should be wanting in discretion if we forgot the necessity for an ample share of control being obtained for British interests, if this particular undertaking is to be carried through; and we feel that we owe it to M. Lesseps to say that he seems himself duly impressed with this sentiment.

M. Lesseps transmits his book accompanied by a very becoming letter, in which he indicates that its publication, as well as a proposed visit to our metropolis, are *intended, consultatively*, both of the people and the governing Powers.

M. Lesseps emphatically declares that he does not hold any mission from the Imperial Government of France.

LIST OF NEW BOOKS, OR NEW EDITIONS OF BOOKS.

CLARK (D. K.)—Railway Machinery: a Treatise on the Mechanical Engineering of Railways; embracing the Principles and Construction of Rolling and Fixed Plant. Illustrated by a series of plates on a large scale, and by numerous engravings on wood. By D. Kinnear Clark. 2 vols. folio, half-bound, £4 15s. (Blackie.)

COPLAND (J.)—The Arithmetic of Fractions and Proportion Investigated and Explained. By John Copland. 12mo, pp. 76, cloth, 2s. (Griffiths.)

FIELDING (N.)—Mixed Tints, showing how they are made, and their Use; together with Hints on the Practice of Oil and Water-Colour Painting. By Newton Fielding. Royal 8vo, pp. 36, sewed, 2s. 6d. (Barnard.)

KEMP (T. L.)—The Phasis of Matter; being an Outline of the Discoveries and Applications of Modern Chemistry. By T. Lindley Kemp, M.D. 2 vols. crown 8vo, pp. 672, cloth, 21s. (Longman.)

LARDNER (D.)—Museum of Science and Art. Edited by Dr. Lardner. Vol. VII., crown 8vo, pp. 216, boards, 1s. 6d.

LE COUTEUR (J.)—The Rifle; its Effects on the War, Military Organization, &c. By J. Le Couteur. 8vo, 3s. 6d. (Porter and Co.)

LIMITED LIABILITY.—The New Act (18 & 19 Vict., cap. 133) for Limiting the Liability of Members of certain Joint-Stock Companies; with Notes. By John Gifford. 8vo, pp. 12, sewed, 3d. (Macdonald.)

MACGREGOR (M.)—Abbreviations—Ecclesiastical, Civil, Military, and Scientific, including those used in Commercial Establishments, such as Custom House, Post Office, Railway, Inland Revenue, Coast Guard. By Michael Macgregor. 18mo. pp. 36, sewed, 3d.

TEMPLETON (W.)—The Operative Mechanic's Workshop Companion and Scientific Gentleman's Practical Assistant; comprising a great variety of the most useful Rules in Mechanical Science, &c. By William Templeton. 4th edition, with Additions, 18mo, pp. 298, roan, 5s. (Weale.)

BARRETT (W. G.)—Genealogical Facts; or, the Crust of the Earth; what it is, and what are its Uses. By the Rev. W. G. Barrett. 12mo, pp. 300, cloth, 3s. 6d. (Hall.)

HARMATH (J.)—Blue Clay as a Manure; to which are added some Remarks on Minerals and Mineral Waters. By J. Harmath. 8vo, pp. 34, 6d. (Houlston.)

HIGGINS (W. M.)—The Earth: its Physical Condition and most Remarkable Phenomena. By W. M. Higgins. New edition, square, pp. 384, cloth, 4s. 6d. (Orr.)

SCHOEDLER (F.) and MEDLOCK (H.)—The Book of Nature: an Elementary Introduction to the Sciences of Physics, Astronomy, Chemistry, Mineralogy, Geology, Botany, Zoology, and Physiology. By Friedrich Schoedler and Henry Medlock. 3rd edition, crown 8vo, pp. 620, cloth, 7s. 6d. (Griffin.)

SIMMS (F. W.)—A Treatise on the Principles and Practice of Levelling, showing its Application to purposes of Railway Engineering and the Construction of Roads, &c. By Frederick W. Simms. 4th edition, revised, with Additions. With Law's Practical Examples for Setting out Railway Curves, and Trautwine's Field Practice of Laying out Circular Curves. 8vo, pp. 214, cloth, 8s. 6d. (Weale.)

ALUMINIUM, THE SO-CALLED NEW METAL.*

MARVELS (if we may judge from the eager manner in which they are received by the bulk of mankind) are the natural food for the sustentation and quickening of many minds. There are few among us who cannot testify to the charm of a really marvellous story. It is indeed quite vexing, while soaring pleasantly in imagination, far from facts and figures, to be brought suddenly, by some friendly monition, into the presence of stern realities, and thereby convinced that we have been merely dreaming. If, however, we do not desire to have our visions thus rudely dispelled, we must choose for our ruminations some field which will not admit of the facile demonstration of the impracticable or impossible. In short, it is injudicious, whatever custom may say to the contrary, to feed the marvellous vein of craving humanity with fictions based upon supposititious progress made in the applied sciences; and that for the simple reason that the deceit, whatever it may be, is so readily discoverable. This, we think, is well understood by all persons engaged in practical science; for whatever class else of the community may take on trust the announcements of wonderful discoveries put forth from time to time, whether they relate to flying machines, the long range, or perpetual motion, we are sure it is not the followers of chemistry or mechanics who place the slightest faith in such fictions. They, however, are subject to fall into an error of an opposite kind, and distrust the value of every suggestion that has not been put to actual trial. This is more especially the case when very important advantages are declared to be attainable by the adoption of some new proposition; for knowing, by experience, how gradual has been the progress in the arts, practical and scientific men are unprepared for great changes; and thus, from their discrediting unattested statements, many valuable discoveries have long been kept in abeyance.

The recent proposition for the adoption into the arts of the metal aluminium, has afforded to the lovers of the marvellous a new subject for speculation. Already its adaptability to a hundred cases is proclaimed, although the difficulty of obtaining it is at present a bar to its use. It is sufficient that the compounds of the metal are capable of being reduced and made to yield the pure metal; that the metal thus obtained is white, tough, not readily oxidisable, and has a lighter specific gravity than iron: and from these facts a world of probabilities as to its ultimate range of application has been put forth. We remember, some years ago, when the great and unexpected yield of copper at the Burra Burra mines affected for a time the market price of that metal, the public was promised penny-pieces as large as dinner-plates. But, far from that, copper has actually advanced in price, and that to a permanent and inconvenient degree; while gold—notwithstanding the prophecies respecting the change which the enormous additions made to it of late years would effect in its market price—still retains its relative value amongst the metals, and has hitherto, as far as we remember, found no new application in the arts to the displacement of any other metal; although its natural peculiarities render it eminently adapted to a variety of untried uses. We are led to make these remarks, in order to abate public expectation respecting the prominent position that aluminium will quickly take in our manufactures. When a ready means has been found to obtain the metal at a price, numerous difficulties may even then present themselves, and call for the exercise of great ingenuity and patience to master them. This was the case with zinc, which, although well known to the ancients, and employed for so many centuries in the production of alloys, has only of late come into extensive use, owing to the difficulties which had to be encountered in its manipulation. But while many enthusiasts are busy in extolling the merits of aluminium as the latest treasure wrested from the storehouse of nature, we think it not unlikely that those whose interest its discovery may most nearly concern will, instead of testing its value by experiment, ignore its very existence until it has forced its way into notice. It is just one of those discoveries which no manufacturer could afford to pursue at his own expense, and for the simple reason that he would gain no equivalent for his labour, because all would participate alike with him in the benefit of his researches. We are glad, therefore, to find that the French Government, in its provident care for the advancement of science, has been at the cost of a series of experiments for ascertaining the best means of reducing aluminium from its compounds to the metallic state. It is at present premature to pronounce an opinion as to the future value of this metal in the arts; but as nothing can give a greater impetus to manufacturing industry in its present advanced state than the introduction and use of new natural products, we propose to lay before our readers the gleanings of the foreign journals which treat of the properties of aluminium, and the mode of obtaining it from its natural combinations.

This metal, which, owing to the recent researches of M. St. Claire Deville, is now exciting so much attention, was discovered, or rather, its existence was inferred, by Sir H. Davy; and the correctness of his inference was confirmed by M. Wöhler, who obtained aluminium in a pulverulent state by treating its chloride with potassium. By modifying M. Wöhler's process, says M. St. Claire Deville, the decomposition of the chloride may be regulated in such manner as to produce a degree of incandescence that will cause the particles of the metal to agglomerate and take the form of globules. On heating a mass, composed of the metal and chloride of sodium (which is to be employed by preference), in a porcelain crucible, to a lively red heat, the excess of chloride of aluminium will be disengaged, and a saline mass, with acid reaction, will remain, in which will be found globules of perfectly pure aluminium. This metal is as white as silver, and eminently malleable and ductile. Nevertheless, on working it, it is found to offer greater resistance than silver; and it is therefore supposed to approach nearer to iron in tenacity. It increases in hardness by being worked, but will regain its former condition by the annealing process. The melting point of aluminium approaches that of silver; its density is 2·56; it may be melted and run off in the open air without undergoing any perceptible oxidation; and it is a very good conductor of heat.

Aluminium is not affected by exposure to either dry or damp air; neither does it tarnish; but it remains perfectly bright, where freshly-cut zinc and tin lose their lustre. It is not affected by the action of sulphuretted hydrogen, nor by hot or cold water. Nitric acid, either weak or concentrated, and weak sulphuric acid, when employed in the cold state, do not act upon it. Its true solvent is hydrochloric acid, from which it disengages the hydrogen, and sesquichloride of aluminium is formed. When heated to redness in hydrochloric acid, in the gaseous state, the product is a dry and volatile sesquichloride of aluminium.

It will be easily understood that a metal which is as white and unchangeable as silver, which is not tarnished by exposure to the air, and which is fusible,

* From "Newton's London Journal of Arts and Sciences."

malleable, ductile, and tenacious, and possesses the singular property of being lighter than glass, would be exceedingly useful if it were possible to obtain it easily. Besides, considering that this metal exists in nature in large quantities, and that its ore is clay, it is much to be desired that the means should be found for bringing it into common use. The investigations of M. St. Claire Deville have led him to hope that this might be the case, as the chloride of aluminium is decomposed with remarkable facility at a high temperature by the common metals; and a reaction of this nature which he is striviug, with the encouragement of the French Academy of Arts, to realise on a larger scale than a mere laboratory experiment, will solve the question in a practical point of view.

In a subsequent report made by M. Deville to the Academy of Arts, he observed that he had caused medals of large size to be struck in aluminium, and also prepared plates of the same, which were not affected by exposure to the air; and further, that small ingots of the same metal, although handled daily, were found to retain their brilliancy: in fact, the substance was so inoxidisable, that it resisted the action of the air even when heated in a muffle to the temperature employed for assaying gold.

Aluminium will not form an amalgam with mercury, and it takes up but a very small quantity of lead. With copper, it forms light alloys, which are very hard and white, even when 25 per cent. of copper is used. It also has the peculiarity of forming with carbon a grey casting, which is granulous and brittle, very easily crystallisable, and containing silicium, which is separated therefrom in a state of purity, on continuing the action of boiling hydrochloric acid.

The following are two methods given by M. St. Claire Deville for obtaining this metal:—

I.—*Sodium Process.*—Introduce into a glass tube, of about an inch in diameter, from 200 to 300 grammes of chloride of aluminium, closing the ends with a plug of asbestos; then conduct hydrogen gas, dry, and perfectly free from atmospheric air, into the tube, and heat the chloride of aluminium in this current of gas by means of charcoal. This will have the effect of driving off the hydrochloric acid, chloride of silicium, and chloride of sulphur, with which it is always impregnated. Capsules of as large size as possible, containing each some grammes of sodium previously crushed between two sheets of dry filter paper, are then introduced into the glass tube. The tube being full of hydrogen, the sodium is melted; and the chloride of aluminium, on being heated, will be distilled and decomposed with incandescence, which may be easily moderated. The operation will be complete when all the sodinm has disappeared, and the chloride of sodium formed has absorbed a sufficient quantity of chloride of aluminium to saturate it. The aluminium will now exist in the state of a double chloride of aluminium and sodium, which is a very fusible and volatile compound. The capsules are next to be removed from the glass tube, and placed in a large porcelain tube, furnished with a pipe leading to a receiver. Through this porcelain tube, while heated to a lively red heat, a current of hydrogen, dry and free from air, is caused to pass; and the chloride of aluminium and sodium will be thereby distilled without decomposition, and collect in the receiver. After the operation, all the aluminium will be found collected in the capsules in the form of large globules: these are washed in water, which will carry off a little of the salt produced by reaction, and also some brown silicium. In order to form a single mass of all these globules, after being cleansed and dried, they are introduced into a capsule of porcelain, into which is put, as a flux, a small quantity of the product of the preceding operation—*i. e.*, of the double chloride of aluminium and sodium. On heating the capsule in a muffle to the temperature of about the melting point of silver, all the globules will be seen to unite into a brilliant mass, which is allowed to cool, and then washed. The melted metal must be kept in a closed porcelain crucible until the vapours of the chloride of aluminium and sodium with which the metal is impregnated have entirely disappeared. The metallic mass will then be found surrounded by a light pellicle of alumina arising from the partial decomposition of the flux.

II.—*Process by means of Galvanism.*—This process is carried on by means of the double chloride of aluminium and sodium. For this purpose, the aluminium bath is prepared by taking two parts by weight of chloride of aluminium, and adding thereto one part of dry pulverised marine salt. The whole is mixed in a porcelain capsule, heated to about 200 degrees. The combination will soon take place, with disengagement of heat. The liquid thus obtained is to be introduced into a capsule of glazed porcelain, which is maintained at a temperature of about 200 degrees. The negative electrode is a plate of platinum, upon which the aluminium will be deposited, mixed with marine salt, in the form of a greyish layer. The positive electrode consists of a porous vessel, perfectly dry, and containing melted chloride of aluminium and sodium, in which is immersed a cylinder of charcoal, which generates the electricity, and to which pass the chlorine, and a small quantity of chloride of aluminium arising from the decomposition of the double salt. The double fixed chloride is re-constituted, and the vapours cease. A small number of elements are necessary for decomposing the double chloride, which presents but slight resistance to the action of electricity.

When the platinum plate is sufficiently charged with metalliferous deposit, it is removed and allowed to cool: the saline mass is then cleaned off, and the plate again introduced into the current. The matter thus detached from the electrode is melted in a porcelain crucible, which is enclosed in an earthenware one; and after cooling, it is treated with water, which dissolves a large quantity of marine salt; and a grey metallic powder is obtained, which is, by several successive meltings, formed into a single mass, the double chloride of aluminium and sodium being employed as a flux for that purpose.

The first portions of metal obtained by this process are nearly always brittle: as fine a product may, however, be obtained by it as by the sodium process; but the chloride of aluminium employed for that purpose must be purer. In fact, by the sodium process, the silicium, sulphur, and iron are carried off by means of the hydrogen,—the iron passing off in the state of protochloride; whilst all these impurities remain in the liquid which is decomposed by the battery, and are carried off along with the first portions of metal reduced.

In addition to these processes of M. Deville, we are enabled to add

M. Bunsen's Method of Preparation.

Take oxide of aluminium, obtained either by the calcination of ammoniacal alum, or from sulphate of alumina, or by the decomposition of alum by chloride of barium; and having mixed it with charcoal, introduce the mixture into a stone retort capable of containing about two quarts, and cover it with a thick layer of cement composed of argil and iron scales. Place the retort in a reverberatory furnace, with its neck projecting horizontally therefrom, from three to five inches, and connect this neck with a glass receiver, for the reception of the chloride of aluminium which is sublimed on the introduction of chlorine. This gas is introduced into the glass receiver by a tube of large diameter, made of glass not easily fusible. The stone retort is heated to a dull red heat, and a current of chlorine (well washed and dried) is caused to pass therein. Chloride of aluminium is then freely formed, and at the expiration of some hours the receiver will contain at least half a pound of product. When this chloride has well cooled, it is mixed with its equivalent of melted and pulverised chloride of sodium, and heat is applied thereto. The mixture will melt at a temperature below 200° Centigrade. It is introduced into a closed porcelain crucible divided into two compartments by a porcelain partition which does not quite reach to the bottom, and closed by means of a porcelain cover, having two holes for the reception of the conductors of the battery. Six or eight pairs of Bunsen's plates will suffice to separate the aluminium. If the temperature remains at 200° Centigrade, the metal will be deposited in the state of powder; and, for the purpose of converting this into a compact mass, pulverised chloride of sodium is gradually introduced into the mixture until the liquid has reached the temperature of the melting point of silver. After cooling, large balls of aluminium will be found in the mass, which are caused to unite by throwing them into melted sea-salt. The ingots thus obtained possess all the characteristics of M. Deville's aluminium.

These processes, it will be understood, are suited rather for the laboratory than for the requirements of the arts: but we hope ere long to be able to present our readers with a more practical plan for obtaining an abundant supply of the metal.

ON THE COMMERCIAL ECONOMY OF WORKING STEAM EXPANSIVELY IN MARINE ENGINES, WITH DESCRIPTION OF A NEW DOUBLE EXPANSIVE MARINE ENGINE.*

By Mr. EDWARD E. ALLEN, of London.

It is proposed in the present paper to consider the practical or commercial advantages of working steam expansively in the marine engine, as distinguished from the theoretical advantages, which latter are better understood and more generally admitted.

It has been established theoretically, that considerable economy is obtainable by working steam expansively. Thus, if steam be allowed to occupy or expand into twice the space it originally occupied, the power developed would be as 1·7 to 1, and according to the following table:—

Spaces occupied by steam ..	1	2	3	4	5	6	7	8	9	10
Power developed	1	1·7	2·1	2·4	2·6	2·8	3·0	3·1	3·2	3·3

The same volume of steam being used in all cases, and allowed to occupy the increased spaces duriug expansion.

Notwithstandiug that this has been long known, it has only been comparatively recently that practical benefit has been derived to any considerable extent from working steam expansively; and even at the present day the principle is but imperfectly recognised, or at least is very inadequately carried out in practice.

The attention of the Institution has been called, on several occasions, to the advantages of working steam expansively, both in engines employed in manufactories, and in mining works, and also in locomotives; and the papers of Mr. Fairbairn, Mr. Samuel, and Mr. Clark have taken up the subject in reference to those particular cases.

The object of the present paper is confined to the advantages of working steam expansively in *Marine Engines*, and to endeavour to arrive at the causes which have hitherto prevented the principle from being as successfully carried out and as productive of economy as in the case of pumping or other stationary engines.

It would almost seem that the apparent necessity of making the engines of steam-vessels occupy the least possible space, actually prevented, for a very long time, any attempt whatever being made to economise fuel; everything being overlooked or considered unimportant, when compared to the supposed advantage of having the engine-space as small as possible.

It was very natural that the first step in the economising of fuel, by working steam expansively, should be taken in places where the spaces which the engines occupied could be almost indefinitely increased; and we find, consequently, that the system of working expansively made very great progress, and may almost be said to have been perfected in pumping and winding engines, before its value was at all recognised in other cases. Pumping-engines had been worked on the expansive principle for some time, before any attempt was made to carry it out in engines employed in the manufacturing districts; this being chiefly owing to the cheapness of coal, and the consequent disregard of economy, and also to the circumstance of a more uniform motion being required.

It will be seen that in the case of engines of manufactories, the ground-space was but little more limited than in the case of pumping-engines, and probably quite as little limited in respect to vertical height. The boiler-room in these cases was also almost unlimited, as also was the weight of the machinery; and

* Paper read before the Institution of Mechanical Engineers.

it was not until the principle of expansion was considered with reference to marine engines and locomotives, that the objections to increased bulk and weight of the machinery became, or appeared to become, so important as to prevent its being carried into practice.

One very important matter appears to have been overlooked in considering the weight of the marine engine; and that is, that it is not simply the weight of the machinery that has to be considered, but the joint weight of the machinery and fuel. It is true, that in the case of the first steam-boats, the weight of the fuel carried did not form so important an item as at the present time; yet, as compared to that of the engine and boiler, it was, and always must be, considerable in every steam-vessel. In river-boats it may be taken roughly at about one-quarter the entire weight of engines, boilers, and water, equal to about 2½ days' consumption, this being the least proportion.

The following Table gives the weight of coals usually taken by steamers, according to the length of voyage, &c.:—

TABLE I.

Proportion of Weight of Coals to Weight of Machinery.

Class.	Service.	Station or Employment.	Number of Days' Consumption.	Proportion of Weight of Coals to Weight of Machinery.
1	River..............	Thames and Clyde...	2½	¼th.
2	Coasting and Continental	General Steam Navigation Company, colliers, &c.	10	Equal.
3	Ocean, short voyages...........	America and Government	15	1½ times.
4	Ocean, long voyages.	Australia...........	40*	4 times.
5	Ocean, proposed voyage out and home	India, &c...........	70	7 times.

* Steamers taking coal equal to only four times the weight of machinery are obliged to coal on the way out and home.

It will thus be seen that, except in river-steamers, any saving in the quantity of fuel must be of vital importance, and the more so in proportion to the length of voyage.

In the large steamer now constructing for the Eastern Steam Navigation Company, the quantity of coals taken is proposed to be seven times the gross weight of machinery; so that any small per-centage of saving would really amount to a considerable quantity.

On one occasion the *Crœsus* took nearly 1,400 tons of coals, being about in the proportion of 7 to 1 to weight of machinery. This quantity was intended to work her outward and part of her homeward voyage.

It will be found that, as a general rule, marine engines are only using their steam expansively to a very small extent, the steam usually being cut off at 3-4ths of the stroke, thus economising in the ratio of 1·3 to 1 only, or say practically equal to a saving of 20 per cent. on the coal consumed if no expansion were allowed to take place.

This amount of expansion is given by the slide alone having sufficient lap on the steam side. It is now usual, however, to fit expansion-valves to the Government engines, as well as to many in the Merchant service, for the purpose of working expansively when short of coal, or when the vessels are running with a fair wind; but these appliances are never designed for continual working. The "link motion" is also used in marine engines for occasional expansive working.

From a pamphlet recently published by Capt. J. C. Hoseason, lately commanding the *Inflexible*, it appears that so far back as 1842 the attention of the Admiralty was called to the subject now in hand, viz., the economy of expanding steam. But at that time the principal difficulty in using steam expansively was doubtless the low pressure at which the boilers were worked, being only about 5 lbs. per square inch.

It appears, however, that in 1842 the pressure in the boilers of the *Inflexible* was raised from 6 to 8 lbs. by Capt. Hoseason's desire, and the pressure in the *Terrible* was fixed at 10 lbs.

In 1849 the Indian Government obtained a paper on the expansive action of steam from Messrs. Maudslay, Sons, and Field; and from the extracts given in Capt. Hoseason's pamphlet, it would appear that the case was fairly made out.

To prove the extent to which the *weight of the machinery* could be increased without increasing the *gross weight* carried, the following example is given:—

"Suppose a vessel with 400-horse-power engines working up to their full power, the consumption would be 30 tons per day, and she would carry 750 tons of coal, which would be 25 days' consumption.

The 400-horse engines would weigh.... 300 tons.
Coal.... 750 „
Total weight 1,050

"Suppose the same vessel with 600-horse engines, but only working up to 400 horse-power, the consumption would then be 22½ tons per day, and she would carry 600 tons of coal, which is 26⅔ days' consumption.

The 600-horse engines would weigh.... 450 tons.
Coal.... 600 „
Total weight 1,050

"Thus, with the larger engines, the vessel will carry 1⅔ days' more coal than with the smaller engines, and would save during 25 days the value of 150 tons of coal."

These facts having been pointed out so forcibly six years ago, it appears strange that the principles upon which they were founded should not have been carried out more fully than they have been. Comparatively, however, nothing has been done, although with respect to the Australian vessels the necessity of economising has increased three-fold, from the quantity of coal required to be carried being just about three times that taken by the Government vessels, viz., about four times the weight of machinery, instead of 1½ times. It will be seen that as the necessity for economy increases, so does the facility or means of producing it increase, from the great proportionate weight of coal upon which a reduction can be made, in order to compensate for any increase in the weight of machinery.

In such cases as the Australian vessels, where the weight of coals carried amounts to four times the weight of machinery, a saving of 25 per cent. of the coals would allow the weight of the machinery being doubled, without the gross weight being increased.

Take, for example, engines of 400 horse-power, weighing 300 tons, and the coals carried 1,200 tons, making a total of 1,500 tons. If the coals, by more economical working, can be reduced to 900 tons, then the engines may be allowed to weigh 600 tons, and the gross weight to be carried will only be the same, the coal saved being equal to 300 tons. Extending Messrs. Maudslay's example, it will be seen by the following Table, II., to what extent the weight of the machinery could be increased without adding to the gross weight, in the case of the coals carried being equal to four times the weight of machinery, the power worked up to being the same.

TABLE II.

Showing the increased Weight of Machinery caused by increasing the Nominal Horse-power or Size of the Engines, and also the necessary reduction in the quantity of Coals taken, so that the gross Weight may remain the same.

Power Worked to	Nominal Horse-power.	Weight of Machinery.	Weight of Coals.	Total Weight carried.	Consumption per day.	Number of days' Consumption.
H.P.	H.P.	Tons.	Tons.	Tons.	Tons.	Days.
Full	400	300	1200	1500	30	40
400	600	450	1050	1500	22½	45
400	800	600	900	1500	20	45
400	1000	750	750	1500	19	40
400	1200	900	600	1500	18	35

From this, it seems that an increase in the weight of machinery to 2½ times still admits of coals sufficient to work for as many days, and saves 450 tons of coal.

The object of the present paper is somewhat different from that aimed at in the pamphlet referred to, although nearly the same considerations are involved. It was then desired to show that both the power and weight of the engines could be increased without increasing the gross weights carried, the increased power being only occasionally used—this being a most important point for war-steamers, and others, when working against the hurricanes in the Indian seas, &c.; this advisable increase of power, however, involving a corresponding increase in the first cost of engines, though attended with counterhalancing advantages.

It is proposed now to show how the *engines alone may be increased* in size for expansive working, and consequently slightly increased in weight, not only without increasing the gross weight carried, but how it can be done so as very materially to *lessen the gross weights* carried—that is, in coal and machinery—leaving greater stowage for cargo.

It is presumed that the power placed in vessels is now sufficient (whether it is so or not does not affect the present question), and therefore, in the examples given, no provision is made for the engine power being even temporarily increased, although this would probably, in many cases, be a great desideratum. Neither are the boilers supposed to be iucreased either in number or size; but, to avoid complicating the deductions, they are supposed to remain the same, especially since at present marine boilers are too much overworked to last any length of time, and an increase of boiler-room relative to the power would be desirable. Strictly considered, however, the weight of the boilers would be diminished in about the proportion of the diminution of coal consumed.

Taking the five classes of steamers given in the preceding Table, I., which shows the weight of coals usually taken in the several cases, it will now be necessary to give the spaces occupied by them in proportion to that occupied by the engines, exclusive of the boilers and passages. The following Table, III., shows the floor or horizontal space occupied by the coal-bunkers in the five classes of steamers.

The engines, boilers, and water are supposed at .... 13 cwt. per H.P.*
The space occupied by coals is taken at .... 45 cub. ft. per ton.
The floor-space occupied by engines alone is taken at .... ¾ sq. ft. per H.P.†

TABLE III.

Proportion of Space occupied by Coals to that occupied by Engines alone.

Class.	Station or Service.	Weight of Coals, in terms of Weight of Machinery.	Depth of Coals in each Class of Vessel, approximate.	Horizontal or Floor Space occupied by Coals, in proportion to Engines alone.
1	River..................	1-4th.	9 feet.	Equal.
2	Coasting and Continental	Equal.	12 feet.	3 times.
3	Ocean, short voyages, and Government....	1½ times.	20 feet.	3 times.
4	Ocean, long voyages....	4 times.	25 feet.	5 times.
5	Ocean, proposed voyage out and home.......	7 times.	50 feet.	5 times.

* See Table IV. † See Table VII.

It will be seen from the above Table, that in the case of Government vessels, where the weight of coals is usually equal to $1\frac{1}{2}$ times the gross weight of machinery, the horizontal space occupied by the coal may be taken at three times the space taken up by the engines themselves (that is, exclusive of boilers and passages), or about equal to the total machinery space, if the boilers and passages be included. This is further explained by Table VI., which gives the examples from which these data are obtained.

In the example quoted above from Messrs. Maudslay, where the coal weighed $2\frac{1}{2}$ times the machinery, instead of $1\frac{1}{2}$ times, which is the quantity more generally taken, the horizontal or floor space occupied would be 5 times that occupied by the engines alone, instead of 3 times, as given above. So that, supposing the passages left the same, the 400-horse-power engines could be replaced by engines of 600 horse-power, and the saving of space required for coal would balance the increased space occupied by the engines, consequently leaving the total weights carried the same, and the total space occupied by machinery and coal (taken together) the same, with the 600-horse-power engines as with the 400-horse-power.

The following Table, IV., is given for the purpose of showing the relative weights of the different parts of the machinery in steam-vessels, and is taken from two tenders supplied to the Government for paddle-wheel engines of 260 horse-power, and screw-engines of 450 horse-power. The Table shows also the average of 18 estimates sent to Government by different engine-makers, giving the separate weights of the various parts of the machinery (as the engines, boilers, water, wheels or screws, &c.)

TABLE IV.

Parts.	Paddle Engines, 260 Horse-power.	Screw Engines, 450 Horse-power.	Paddle Engines, Average of 18 Estimates, 453 Horse-power.	General Average per Horse-power.
Engines	80 tons.	127 tons.	127 tons.	5·70 cwt.
Boilers and fittings	45 ,,	55 ,,	63 ,,	2·95 ,,
Water	30 ,,	45 ,,	$42\frac{1}{2}$,,	1·90 ,,
Coal-bunkers	10 ,,	15 ,,	$15\frac{1}{2}$,,	·70 ,,
Wheels	13 ,,	30 ,,	$28\frac{1}{2}$,,	1·20 ,,
Spare gear	12 ,,	18 ,,	$16\frac{1}{2}$,,	·75 ,,
Total	190 tons.	290 tons.	293 tons.	13·20 cwt.

It will be sufficiently near for the present purpose, therefore, to consider the relative weights of the different parts of marine engines to be as follows, viz.:—

Engines	$5\frac{1}{2}$ cwt.	per nominal horse-power.
Boilers and fittings	3 cwt.	,, ,,
Water	2 cwt.	per nominal horse-power.
Wheels or screw	1 cwt.	,, ,,
Spare gear	$\frac{3}{4}$ cwt.	,, ,,
Coal-bunkers (containing about 15 cwt. per horse-power)	$\frac{3}{4}$ cwt.	,, ,,
Total	13 cwt.	,, ,,

The practical applications which are made of these particulars in the calculations contained in this paper are, first, that the weight of marine machinery may be fairly assumed at 13 cwt. per nominal horse-power; and secondly, that the weight of the engines and spare gear together may be taken at *one-half* of the gross weight of machinery. This consideration is of much importance, as it is the engines alone that are supposed to be increased in size and weight, to admit of greater expanion of the steam; the boilers and wheels or screw being supposed to remain the same, as has been before stated.

Table V. gives the total space occupied by the machinery and coals relatively to the entire hulls, and includes the averages of six vessels with side-lever engines, and six vessels with direct-acting engines, all belonging to the Peninsular and Oriental Steam Navigation Company; also the average of 1,200 English merchant-vessels.

TABLE V.

Average Registered Tonnage.	Average Tonnage of Engine-room.	Average Total Tonnage.	Average Horse-power.	Per-centage of Engine-room to Total Tonnage.	Average Total Tonnage, per Horse-power.
Average of 6 Side-lever Engines, P. and O. S. N. Co.					
1,156	913	2,069	636	44 per cent.	3·25
Average of 6 Direct-acting Engines, P. and O. S. N. Co.					
1,659	854	2,513	794	34 per cent.	3·16
Average of 1200 English Merchant Steamers.					
138	108	246	83	44 per cent.	2·95

From Table V. it appears that from 34 to 44 per cent. of the *whole capacity* of the vessels is occupied by the engine-room and coals. The Table also gives the most general proportion of power to tonnage as 1 horse-power to every 3 tons.

Tables VI. and VII. give the particulars of several steamers with both screw and paddle-wheel engines, from which the comparative spaces occupied by the coals and machinery will be seen.

TABLE VI.

No.	Name of Vessel.	Screw or Paddle	Tonnage.	Horse-power.	Assumed Weight of Machinery at 13 cwt. per Horse-power.	Tons of Coal carried.	Weight of Coal per Horse-power.	Total Engine-room (including Coals). Length.	Beam.	Depth.	Horizontal Area.	Horizontal Area per Horse-power.	Bulk of Coal, 45 cubic feet to the Ton.	Assumed Depth of Coal in Bunkers, 4-5ths of Engine-room.	Horizontal Area of Coal Space.	Horizontal Area of Coal per Horse-power.
					Tons.	Tons.	Tons.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Sq. ft.	Sq. ft.	Cubic ft.	Feet.	Sq. ft.	Sq. ft.
1	Termagant	Screw	1,547	620	403	280	·45	85 0	39 4	45 9	3,343	5·39	12,600	20	630	1·01
2	Bosphorus	Screw	536	80	52	150	1·87	30 0	25 0	say 16 6	750	9·37	6,750	13	520	6·50
3	Terrible	Paddle	1,847	800	520	800	1·00	78 7	38 0	27 4	2,986	3·73	36,000	22	1,636	2·04
4	Odin	Paddle	1,326	560	364	445	·79	60 0	34 4	20 0	2,060	6·67	20,025	16	1,251	2·23
5	Asia	Paddle	2,130	800	520	900	1·12	92 6	40 6	27 6	3,746	4·68	40,500	22	1,841	2·30
6	La Plata	Paddle	2,403	1,000	650	1,200	1·20	82 9	40 8	27 8	3,365	3·36	54,000	22	2,454	2·45
7	Proposed Australian, direct	Paddle	3,188	800	520	1,500	1·87	72 0	45 0	32 0	3,240	4·05	67,500	26	2,596	3·24
	Averages		1,854	666	433	754	1·14	71 7	37 7	25 3	2,690	4·04	33,911	20	1,695	2·54

TABLE VII.

Name of Vessel.	Name of Engineer.	Description of Engines.	Screw or Paddle.	No. of Cylinders.	Diameter of Cylinders.	Length of Stroke.	Horse-power.	Length of Engine (fore and aft)	Breadth of Engines.	Area of Floor Space.	Height above centre.	Area of Floor Space per Horse-power.
					Inches.	Ft. In.		Feet.	Feet.	Sq. ft.	Feet.	Feet.
Simoom	Watt and Co	Horizontal oscillating	Screw	4	44	2 6	350	13	16	208	3	·59
Niger	Maudslay	Do. short connecting rod	Screw	4	$47\frac{5}{8}$	1 10	400	15	16	240	$3\frac{1}{2}$	·60
Arrogant, &c.	Penn	Do. trunk	Screw	2	55	3 0	360	11	24	264	3	·73
Conflict	Seaward	Do. short connecting rod	Screw	4	46	2 0	400	20	21	420	$2\frac{3}{4}$	1·05
Vulcan, &c.	Rennie	Do. do. do.	Screw	4	$49\frac{1}{2}$	2 0	350	$13\frac{1}{2}$	$17\frac{1}{2}$	236	$3\frac{3}{4}$	·67
Frankfort	Thompson	Inverted vertical	Screw	2	40	2 10	100	11	$14\frac{1}{4}$	157	12	1·57
Pomone	Holm	Horizontal steeple	Screw	2	46	3 10	220	$15\frac{1}{2}$	21	326	$3\frac{1}{2}$	1·48
Minx	Seaward	Do. short connecting rod	Screw	2	..	..	10	7	$7\frac{3}{4}$	54	1	5·40
Retribution	Maudslay	....	Paddle	..	..	..	800	$23\frac{1}{2}$	24	554	..	·69
Thunderbolt	R. Napier	....	Paddle	..	..	..	300	$15\frac{3}{4}$	$17\frac{1}{2}$	275	..	·91
Vulcan	Fairbairn	Direct-acting	Paddle	2	$80\frac{5}{8}$	5 $9\frac{1}{2}$	476	$12\frac{1}{4}$	$19\frac{1}{2}$	239	..	·50
Black Eagle	Penn	Oscillating	Paddle	2	62	4 6	260	$10\frac{3}{4}$	$21\frac{1}{2}$	231	..	·88
Amazon	Hick	....	Paddle	..	..	..	300	16	$17\frac{1}{2}$	280	..	·93
Clyde, Tay, Tweed, &c.	Caird	Side-lever	Paddle	2	..	..	460	27	$23\frac{1}{2}$	634	..	1·37
Averages	....	....	....	..	..	..	342	15	19	285	..	·83

From these Tables several important particulars may be deduced:—

1st.—That in Government vessels the general proportion of coal taken is 1 ton per nominal horse-power, equal to about $1\frac{1}{2}$ times the gross weight of machinery, as before given.

2ndly.—That the horizontal space occupied by the entire engine-room, when this proportion of coal is taken, is about 4 to $4\frac{1}{2}$ square feet per nominal horse-power.

3rdly.—That the space occupied by the coal-bunkers, carrying this proportion of fuel, may be taken at 2 or $2\frac{1}{4}$ square feet per horse-power, or about 3 times the space occupied by the engines alone, exclusive of boilers, passages, &c.

4thly.—That the space occupied by the engines alone, exclusive of boilers, coal-bunkers, and passages, may be taken at $\frac{3}{4}$ square feet per nominal horse-power—that is, where the engines are direct-acting.

From an average of the 18 estimates furnished to Government by different makers, and from some other cases, it appears that the space occupied by the boilers alone may be taken at about 1 square foot per nominal horse-power, and that the total price of £43 per horse-power for the machinery may be thus divided:—

	£	s.	d.	
Engines, boilers, and coal-bunkers...	38	0	0	per horse-power.
Wheels	2	10	0	„ „
Spare gear	2	10	0	„ „
Total................	£43	0	0	„ „

The amount for engines, &c., may be divided nearly as follows:—

	£	s.	d.	
Engines	24	0	0	per horse-power.
Boilers	12	0	0	„ „
Coal-bunkers.......................	2	0	0	„ „
Total................	£38	0	0	„ „

These proportions will be quite near enough for the purpose required, and the relation they bear to each other will not be much influenced by the present increased prices.

It will therefore be assumed that the cost of the engines alone is about one-half the entire cost of machinery.

It will be requisite further to consider the average *annual expense* of the coal used by steam-vessels, and its proportion to the cost of the vessels or capital; this depending partly upon the class of vessel, and partly upon the service upon which she is engaged.

(*To be continued.*)

ON THE MANUFACTURE OF STEEL, AS CARRIED ON IN THIS AND OTHER COUNTRIES.*

By Charles Sanderson.

(Continued from p. 217.)

In contrasting the steel manufacture of England with that of America and the Continent of Europe, I propose, first, to form an estimate of the *weight* of steel manufactured in each country, and of *its value* as an article of commerce; secondly, to show that England produces a greater weight of steel than the whole of the Continent of Europe and America, and also, by a comparison of the degree of perfection attained in each country, to prove that whilst England produces a greater weight of steel, she also eminently excels other countries in her knowledge of this branch of manufacture.

From these two heads I shall show the importance of this branch of our industrial commerce as a source of wealth to the nation, and contrast the high superiority of the various steels made in England with those produced in other countries, proving not only that the annual value is of importance to us as a manufacturing community, but that our scientific knowledge and practical skill have placed us very greatly in advance of other nations in the production of steel.

The following Table shows the production of steel in France:—

Year.	Raw Steel.	Converted Steel.	Total Production.
	Tons.	Tons.	Tons.
1826	3,257	1,500	4,757
1835	2,949	3,308	6,257
1840	3,546	3,859	7,405
1841	3,202	3,684	6,886
1842	3,527	5,812	9,339
1844	3,212	7,782	10,994
1845	4,004	8,369	12,373
1846	4,408	8,546	12,954

The manufacture of steel in France is considerable. They produce natural steel from the white iron of Dauphiny, and the metal produced from the spathose ores, which latter they import. The manufacture of converted and cast steel has, during the past ten years, become important. The principal works are situated at St. Etienne, at which Swedish iron is mostly used, as at Sheffield. Although the French produce a considerable weight of cast-steel, yet its quality is by no means equal to that produced in England, since English cast-steel is now largely imported, particularly for superior purposes.

Of the above it must be noticed that the raw material is not the manufacture of the country, but a large portion is imported from Sweden; yet the Table shows the weight of steel produced annually in this country.

In 1846 the produce is estimated at 12,954 tons, of which 4,408 were raw or natural steel, and 8,546 converted steel.

There is no return of refined steel; but as it is manufactured from the raw steel, it does not affect the statistical account. Cast-steel being only made by two or three houses in France, the weight is not to be exactly obtained.

The raw steel is higher in France than in other countries, as it is protected by the import duties. I estimate it at £25 per ton.

The weight of cast-steel I estimate in round numbers at 2,000 tons, which I value at £60 per ton, on account also of the protective duty. The iron for this production is imported.

The value of the steel produced in France is—

	£	s.	d.
12,954 tons natural and converted steel, at £25 per ton	323,850	0	0
2,000 tons cast-steel, at £60 per ton	120,000	0	0
14,954 tons.	£443,850	0	0

In the Prussian dominions the major part of the steel produced is manufactured in Westphalia, around Remscheid, Lohngen, and Hagen. A portion is made in Silesia, Thuringia, and the Brandenburg district, in which there exist several converting furnaces.

The produce of the kingdom is as follows:—

Year.	Raw Steel.	Refined Steel.	Cast Steel.
1837	103,938	42,472	682
1838	101,820	60,308	818
1839	100,526	56,309	727
1840	97,930	68,602	636
1841	100,697	69,496	909
1842	95,926	61,483	909
1843	107,730	60,794	909
1844	100,642	68,391	1,500
1845	109,427	70,480	1,750
1846	81,966	47,449	1,223
1847	112,672	54,209	4,357
1848	105,276	51,644	5,069
1849	88,040	53,661	11,121
1850	107,674	68,379	17,645

These weights are in Prussian zentners.

In this Table the converted steel is included in the weight of raw steel, from which material both refined and cast steel are produced.

The number of furnaces employed to produce this steel are, 143 charcoal fires, or refineries for raw steel; 105 furnaces for refining raw steel; 7 converting furnaces; 58 melting holes, or furnaces.

In 1850 the Brandenburg district produced 3160 zentners of converted steel.

	Zentners.	
Silesia produced	1,630	raw steel.
Sax Thuringia	4,918	do.
Westphalia	41,261	do.
„	57,220	refined steel.
„	17,336	cast-steel.
Rhenish Prussia	56,605	raw steel.
„	11,159	refined steel
„	309	cast-steel.

The refined steel is largely used in the manufactures of the country; a further quantity is exported to the United States of America, to France, and to Spain. The raw steel is used for common purposes. The cast-steel is principally made into railway springs and axles. The refined steel is, of course, manufactured from the raw steel.

In estimating the value of the whole produce, I deduct the waste of metal which arises from the refining process, so as to obtain the net remainder of raw steel; this waste I estimate at 15 per cent. upon the weight produced in 1850, 68,379 cwt.; this will consume 78,634 cwt. Also, cast-steel made both from raw and converted steel.

Of the 17,645 cwt. manufactured, I estimate 10,000 cwt. as produced from raw steel, and 7,645 from converted steel. 88,634 cwt. of raw steel is therefore consumed in the manufacture of refined steel and cast-steel, leaving 19,040 cwt. for common uses, or exportation.

I estimate the whole of these products as follows:—

Cwts.		Tons.		
68,379	or	3,419	refined steel, at 100 dols. per 1,000 lbs. Prussian, or £30	£112,570
17,645	or	882	of cast-steel, at £45 per ton	£39,690
19,040	or	952	raw steel, at 65 dols. per 1,000 lbs. Prussian, or £19 10s.....	£18,564
		5,253 tons.		£170,824

The weight of pig-iron consumed in Austria in 1848 was 368,000 cwt., equal to about ten per cent. of the whole product of the blast-furnaces of that country, including Hungary. This metal produced 287,300 cwt. of raw steel, of which 80,000 to 90,000 cwt., or 4,500 tons, were consumed in the country in the form of steel, more or less refined, for the manufacture of scythes, files, and tools, besides the raw or common steel used for agricultural implements and the like.

The exportation in five years, from 1843 to 1847, was equal to 87,120 cwt., or 4,356 tons, shipped from Trieste to the Levant, Mexico, and South America.

* Paper read before the Royal Society of Arts.

The product of converted steel in 1848 was 125 tons; the product of cast-steel in 1848 was 210 tons, obtained chiefly from the melting of raw steel.

From the above statement, the product of refined steel is 8,856 tons, and 15 per cent. for waste in producing it from raw steel; and I find it requires 10,184 tons to produce it, leaving 4,181 tons of raw steel for common purposes, named above.

I estimate the whole produce of Austria as follows:—

Tons.		£	s.	d.
4,500	refined steel, for manufacturing in the country, at £30 per ton	135,000	0	0
4,356	steel exported, all sizes, averaged at £24 per ton	104,544	0	0
4,181	raw steel, used for common purposes, £19 10s. per ton	81,529	0	0
13,037 tons.		£321,073	0	0

Sweden produces both keg and steel in faggots, which is chiefly shipped to the East Indies. The demand is very variable for this steel, and whilst at one time a considerable quantity may be produced if the demand is brisk, at another their forges produce iron, which they can at all times either sell or send to the general dépot at Stockholm.

Denmark, Holland, Spain, Portugal, Sardinia, and Italy, produce no steel of importance.

In the United States of America raw or natural steel is not produced; the only kind at present manufactured is converted steel, produced from the Russian and Swedish irons so largely imported by them. In a country which is advancing so rapidly it is impossible to form any distinct estimate of the weight manufactured, but, from my personal knowledge of the extent of it, I consider that 10,000 tons is a large estimate. Several attempts have been made to produce cast-steel in New Jersey and Pittsburg, but hitherto without success.

The American blister steel is quoted at 5 cents per lb., or 102 dols. per ton, which, at 8 per cent. exchange, is equal to about £21 5s. per ton; on 10,000 tons this would represent a value of £212,500.

The manufacture of steel in England is chiefly confined to Sheffield, although it is also made at Newcastle and in Staffordshire. I have already shown, in the early part of this essay, that the importation of Swedish iron, combined with that furnished from English materials, amounts to from 40,000 to 50,000 tons per annum; of course this weight represents the quantity of steel manufactured of every description.

Mr. Scrivenor estimates the number of furnaces in Sheffield and its neighbourhood as follows:—

	Converting Furnaces.	Cast-steel Furnaces, or Holes.
1835	56	554
1842	97	774
1846	105	974
1853	160	1,495

Now, a converting furnace will produce 300 tons of steel per annum; but if I estimate each to produce 250 tons, 160 converting furnaces would represent a make of 40,000 tons of steel a year in Sheffield alone. Again, he says there are 1,495 melting-holes: now, each furnace of 16 holes will melt 200 tons; this, therefore, shows a product annually of 29,900 tons: but as such furnaces may not all be in continual work from various causes, I have estimated the quantity of cast-steel manufactured in Sheffield at 23,000 tons. The weight of coach-spring steel I have estimated at 10,000 tons, leaving a remainder of 7,000 tons of bar for the manufacture of German, faggot, single and double shear-steel. As regards the price, I take cast-steel at £45 per ton; its commercial value varies from £35 to £60 per ton net, and as a large quantity of the cheaper steel is sold, I have fixed £45 per ton on an average. The price of bar-steel is below the real value, since it includes all shear-steel, the best of which sells at £60 per ton, whilst, however, a portion of this 7,000 tons sells only at £28, and some even lower. The price of coach-springs is the price now paid for them.

I estimate the weight and value of the steel made in England as follows:—

Tons.		£	s.	d.
23,000	of cast-steel, all qualities, at £45 per ton ..	1,035,000	0	0
7,000	bar-steel, including German, faggot, single and double shear-steel, average £35 per ton	245,000	0	0
10,000	coach-spring steel, £19 per ton	190,000	0	0
40,000 tons.		£1,470,000	0	0

From the foregoing statistics, we find that

				£	s.	d.
France	produces	14,954 tons,	average value of	443,850	0	0
Prussia	,,	5,453 ,,	,,	170,824	0	0
Austria	,,	13,037 ,,	,,	321,073	0	0
United States	,,	10,000 ,,	,,	212,500	0	0
England	,,	40,000 ,,	,,	1,470,000	0	0

Such is the contrast of the manufacturing power of the steel-producing countries; it shows the eminent position of England, in both weight and value: this can only arise from the practical skill and scientific knowledge which we have brought to bear upon its manufacture, and the active energy which has enabled us to produce steel *suitable for every purpose in the arts.* This superiority not only enables our manufacturers to maintain the high position they now hold, but to increase it yet further; for we daily see our production expanding, not only to supply the wants of our home manufactures, but also for the Continent of Europe, as well as the United States of America and Canada.

In conclusion, I may add, that whilst it is a business which affords a fair manufacturing profit to those who have embarked in it, it also adds very largely to the wealth of the empire. The working classes also enjoy its benefits; independent of the well-paid labour required to produce steel to the value of one and a half millions sterling, it gives occupation to the collier by causing a consumption of 120,000 tons of coals annually. I add

A LIST OF THE DUTIES IMPOSED BY VARIOUS COUNTRIES UPON STEEL.

The Zollverein..	1 dollar 15 silver groschen per cwt.
Austria	4 florins per Vienna centner.
Belgium	80 centimes per 100 kilogrammes (about 2 cwt.)
France	£13 4s. 0d. per ton on bars, £32 per ton on sheets.
Sweden	Cast-steel, 6 rix-dollars; refined steel, 15 rix-dollars; raw and converted steel prohibited.
Russia	75 copecks per pood, = to 36 lbs. English.
Holland	20 kreutzers per Dutch centner.
United States of America	15 per cent. *ad valorem* on cast, shear, German, &c., in bars; and 20 per cent. *ad valorem* on sheet and blistered steel.

CORRESPONDENCE.

HOARE'S IMPROVEMENTS IN THE APPLICATION OF THE SCREW-PROPELLER.

To the Editor of The Artizan.

SIR,—In the last number of your valuable Journal, I perceive a description by Mr. Hoare of his improvements in the screw-propeller. As any invention relating to the method of propelling steam-vessels must possess very great interest to the generality of your readers, you will perhaps permit me to make a few observations upon the practicability of Mr. Hoare's invention. The principal feature of the invention is the application of the propeller-shaft at an angle to the body of the vessel, by doing which, he says, the slip of the screw is obviated, and that most important desideratum a perfect fulcrum obtained. To use the inventor's own words—"The water is driven away in a direction in which it meets a denser fluid. It cannot escape without taking a direction upwards, but this it cannot do before the screw has left one body of water to act on another; consequently, as the water cannot leave the screw, it must give the whole power of the engine to the propulsion of the vessel." This is all very well; but it must be borne in mind that whatever the form of the screw, the power is invariably transmitted through and in a line with the propeller-shaft. It follows, then, that if the propeller and shaft are at an angle to the body of the vessel, as Mr. Hoare proposes applying them, a considerable amount of the power of the screw is lost, and that in the same ratio as the tendency of the screw to lift the stern of the vessel out of the water: and it will be found in all cases that the power thus lost more than balances that gained by the working of the screw in deep water. The inventor, in summing up, says the advantages of his system are economy of power, economy of space, less working expenses, and less wear and tear. Upon the saving of power I have already treated, and it requires but little study to see that the space, working expenses, and wear and tear must remain the same, as the only difference in Mr. Hoare's from the present method is the applying of the propeller at an angle. The inventor also suggests the use of two propellers on each side of the stern of the vessel, showing an inconsistency in his suggestions really remarkable; for he first of all proposes fixing the screw at an angle to the vessel—the object being to get a greater volume of water above, and thus obviate the slip of the screw—and afterwards suggests the application of two screws, one on each side of the stern. It will be very evident that to get a sufficient volume of water between the propeller and the side of the vessel, they must be placed a most inconvenient distance apart. Trusting that Mr. Hoare will soon acquaint us with the result of his experiments,

I remain, Sir, yours, &c.,

Dowlais Works, Sept. 23, 1855. JOHN TRURAN.

LABOUR-SAVING MACHINES, &c. BY SIR SAMUEL BENTHAM.

To the Editor of The Artizan.

SIR,—Conformably to the specification of Sir Samuel Bentham's patent of 1793, machines made by him were actually at work in 1795: he possessing no steam-engine, they were put in motion by manual labour; yet, strange to say, though that specification originated most of the machines for fashioning wood, metals, and stone, now worked by steam power, no instance has come to my knowledge of a hand or foot-moved apparatus for working such materials. The people of the United States have profited by this patent in their workshops, where small machines, worked by hand or foot, are used, for shaping wood especially. So, in Ireland, it appeared in the account of the National Exhibition, that a mechanist exhibited engines suitable for small workshops. The *Times* of the 7th inst. mentions several operations performed in Canada by machinery evidently set in motion by hand or foot. Are Britons to be the last to adopt Sir Samuel's machines for aiding the smaller carpenters, joiners, &c.?

The machines, worked in 1795, which it would seem particularly desirable to introduce in the lesser workshops, are, amongst others, the following:—

A work-bench, scarcely exceeding in size a cube of three feet, on which was mounted an improved circular saw. This saw was set in motion by the foot of the workman; a moveable table enabled it to cut the material to any angle or depth. A similar machine is employed in the Portsmouth block-making machinery, for cutting off the angles of pieces of wood for block-shells. The machine is also applicable to the cutting of grooves, dove tails, rabits, mortices, &c. By its use the accuracy of machinery would be substituted for the chance skill of the operative.

A machine for cutting mouldings, which, with appropriate tools, would form them of any depth or shape.

A reciprocating saw frame.

A machine for curved work, cutting the material to any required form, according to the mould inserted to guide the apparatus.

A machine for sawing veneers, however thin, without the usual loss of the precious kinds of wood.

But it seems needless to proceed in the enumeration of machines, as the specifications of Sir Samuel's patents have been published in "The Repertory." An edition of that of 1793 was also published by the late Mr. Prosser, of Birmingham, and is easy of consultation, its items being indicated by marginal contents.

18th September, 1855. M. S. Bentham.

SMALL PUMPING-ENGINES.—SIR SAMUEL BENTHAM.

To the Editor of The Artizan.

Sir,—The Artizan of this month proposes that a small steam-engine should be employed for pumping the caisson in Portsmouth Dockyard; and, certainly, good economy would require the substitution of steam-power to manual labour, wherever it can advantageously be employed. It was on this account that Sir Samuel Bentham, in the year 1801, contrived *moveable* steam-engines, placing those for land-service on *wheels*; and it may be suggested that an engine of this description might suffice for the occasional pumping of the caisson in question.

Extensively as steam-engines on wheels are now employed on railroads, &c., there remains a use to which they have not hitherto been applied, that of pumping water out of shallow docks, thus enabling them to answer the purpose of deep ones, as explained in Sir Samuel's "Statement of Services," p. 68. This publication being now in few hands, a recital of the article in your pages may not be thought irrelevant: it is as follows:—

"The having proposed and effected the introduction of moveable steam-engines."

"The first engine of this kind was for use in Portsmouth Dockyard. It is upon wheels, and is applicable to the working of cranes, pumps, &c.

"The employing of moveable steam-engines, whether on wheels for service on shore, or in a boat or larger vessel for service afloat, affords the means of applying this advantageous *primum mobile* to a variety of temporary purposes, such as would not afford compensation for the expense of a fixed steam-engine. One purpose for which I proposed it generally for all dockyards, was that of pumping water out of and into the present docks, whereby, over and above the saving in the expense of pumping, the docks would be rendered much more efficient than at present. By this means, ships at any draught of water at which they can be brought over the sill of the gate of a dock, could afterwards be floated upon blocks of any height, by the simple expedient of pumping water into the docks, without incurring the expense of a separate steam-engine, or that of drains of communication for each dock."

18th September, 1855. I am, Sir, &c., M. S. Bentham.

SPECULATIONS ON THE FORM OF SHIPS.

To the Editor of The Artizan.

Perhaps there is no general subject that can be considered of greater importance than the form of our ships, either for war or for the commercial navy; and as the subject is of such vast importance in a national point of view, I trust a short statement and a few suggestions may be considered worthy of admission into the pages of your scientific and useful Journal.

The question, Which is the best form?—the adaptation of theory and practice to one great result—seems to be as unsettled as ever; and if we may judge from the varieties in the moulds of ships in different parts of the kingdom, the builders of which are daily experimenting on some new form of mould, the solution of the question is still a matter of experiment.

Some ships are celebrated for their want of ease and stability; others are incapable of using their armaments in rough weather, or are defective in the proper qualities essential for due command by rudder or sail: so that the exceptions, of ships of good quality, are less numerous than imagination would lead us to suppose as existing in fleets belonging to a nation eminent for its scientific and practical mechanical talent; and certainly there must be a sad and most blameable want of essential fundamental knowledge in high as well as in low places, which has recently allowed a vast sum of the national money to be wasted in the new floating gun-batteries, now found to be useless from the miscalculation, or no calculation at all, of the quantity of displacement in the element in which they were to float. A lover of his country—one who can really feel the depth of the sentiment of the poet—

"England, with all thy faults, I love thee still"—

must be disheartened at much that is taking place in the momentous affairs of the present day, and if there was no trust that Providence would overrule all for better ends than we can understand, might well despair in the prospect of the future.

Sir Walter Raleigh, in his "Discourse on the Royal Navy and Sea Service," in 1610, recorded these just and true opinions—at least, can they be disputed? He says, in building a ship these six things are principally required:—

1. That she should be strongly built.
2. That she be swift.
3. That she be stout-sided.
4. That she carry out her guns all weathers.
5. That she hull and tyre well.
6. That she stay well when boarding and turning on a wind is required.

And then he remarks, "that for swiftness she must have a long run fore and aft, but with just proportions, that she may neither sink into nor take in the sea, but lie clear off above it; and that the shipwrights be not deceived herein (as for the most part they have been), they must be sure that they sink no deeper in the water than they promise; for otherwise the bow and quarter will utterly spoil the sailing." And he ends his other observations, alluding to long ships, by these words: "It is a special observation, that all ships sharp before, that want a long floore, will fall roughly into the sea, and take in water over head and ears."

I am not a sailor by profession, neither am I a shipbuilder; but I have made many long voyages, and have been several times in the tempestuous ocean of long waves off the "Cape of Storms;" and I have never yet made a voyage in a ship celebrated for quick sailing that did not, as Sir Walter says, "fall roughly into the sea, and take in water over head and ears."

The application of iron to form ships wonderfully facilitates improvements and experiments in form, which were in some degree limited formerly by being confined to one material—wood.

It is a known historical fact, that during the last great war, the ships of the English navy (gallantly manned and fought as they were) were inferior in sailing qualities to those of many other nations. The same defects existed in our commercial vessels; so that the enterprising Americans seized the opportunity of their neutrality, improved the sailing qualities of their commercial ships, and became the great and the fastest carriers of commerce throughout the world. It was difficult to find a place where an American ship was not to be found.

A singular circumstance occurred in our own country, about the year 1790, which ought never to be forgotten. A patriotic bookseller, Mr. Sewell, the proprietor of the "European Magazine," made an excursion to the seaports of our coasts, and attentively remarked and pondered upon the universal complaints of the marked inferiority of the British ships compared with those of other nations, and, with the true feelings of a patriot, he determined to devote the covers of his Magazine to the free insertion of any papers on the subject of improvements in naval architecture; and, more than that, he devoted a room in his house for the reception of models and drawings upon the subject, as well as for meetings for discussion, in the hopes of eliciting some benefit to his country.

From this beginning, a number of noblemen and gentlemen determined to form a society for promoting improvements in naval architecture. His late Royal Highness the Duke of Clarence was president, and their first meeting was held at the Crown and Anchor Tavern, Strand, Thursday, 14th April, 1791.*

From this society originated a series of expensive and painstaking experiments, in the Greenland Docks, "on the resistance of fluids to solid bodies." They were commenced and principally carried on by the late Colonel Mark Beaufoy, and latterly, from funds failing, at his sole expense, assisted in his calculations for nearly ten years by his amiable and scientific wife; and the result of the labours were afterwards published for private distribution at the expense of Mr. Beaufoy, the son, after his father's death.

From these experiments, it was found that by increasing the length of a solid of almost any form by the addition of a cylinder in the middle, the resistance with which the solid moved in the water was exceedingly diminished:

Also, that a cone will move through the water with its apex foremost with less resistance than with its base, contrary to the generally-received idea:

Also, that a broad and long plank will move through the water, when its broadsides are placed horizontally, with greater ease than when the plank is placed on its edge, or with its broadsides perpendicularly. And it is upon the principle of this last experiment that I rest the suggestion I shall proceed to explain.

In adopting the form of a ship to suit commercial purposes, we must keep in view two essential points:—

1. A proper space and safe stowage for cargo.
2. Swiftness in sailing, that she may complete her voyages as rapidly as possible.

Now, as far as my observation has enabled me to remark, from vessels that I have seen in the Clyde, at Liverpool, and in the docks and building-yards of this great city, the object of swift sailing seems to be that principally aimed at, especially in the iron-made vessels: and to accomplish this, the bows and quarters are made as sharp and narrow as possible, the beam or breadth of the ships are rather reduced, and extra length added to give capacity for cargo. Hence the principle adopted is that of the plank with the broadsides perpendicular.

Now, let me earnestly entreat a little attention to the proposal of trying the principle of the plank with broad faces horizontal — just the reverse of the practice now adopted: for I imagine that ships of the first construction—that is, of the principle of the perpendicular plank with sharp bows—will have a tendency to plough through the sea; and that those of the shape I propose will be more suited to sledge over the waves, as it were, and thus be easier, swifter, and less liable to take in seas at the bow, sides, or stern.

As water is a non-elastic medium, and the solid floating in it can only possess this property by displacing a volume of the water equal in weight to that of the whole solid body with all its contents above and below the water-line—the buoyancy being derived from the pressure of the water upwards to recover its natural level—the same quantity of displacement must take place, whatever shape the floating solid may be; but if it is narrow, it will sink deep, and occupy less horizontal space—if broad, its displacement will be shallow, but broader: therefore, the question is, which shape will require the greatest power to propel it through the water? But the experiments of Colonel Beaufoy have already determined, that by placing the plank flatways or horizontally with regard to its broad faces, the least resistance was experienced.

Now, the consideration is, how to apply this principle to the shape of a

* It is a singular circumstance, and shows the lukewarmness of our Government authorities, as well as the public generally, on so important a subject, that the society soon died away for want of members to support the funds.

vessel's hull; and I will, therefore, offer a suggestion or two upon the subject, which, I trust, may be taken up by some practical and independent builder, as they are simple, easy, and rational.

Fig. 1.—Plan of the Vessel on her upper deck.

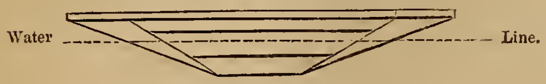


Fig. 2.—Side view.

Suppose a form similar to that of Figs. 1 and 2 is chosen; to give an easy angle of incidence, the slope must begin from the extremities of the bow and stern to meet the midship part of the vessel.

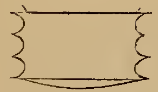


Fig. 3.

Fig. 4.

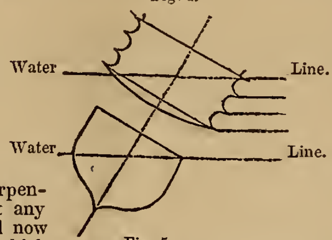


Fig. 5.

I propose the vessel to have perpendicular and parallel sides, without any curve or bend, except what I will now describe; and the advantages of which will be presently pointed out. I propose to divide the height of the side into three or four equal spaces, which spaces are to be covered by as many semicircular channels or grooves running horizontally fore and aft—these, in an iron-built ship, are easily made—a section midships will then present the form of Fig. 3. This form will not only cause the vessel to be stout-sided, but it is evident that every rising wave striking the side of the ship will be broken and thrown off from the vessel; and when sailing on a wind, and leaning over, as represented in Fig. 4, the lower projecting curves of the grooves or channels will present themselves in direct opposition to the pressure which causes a vessel to go to leeward; which is not obtainable in the sides of a ship of the common form when leaning over, as shown in Fig. 5. Hence, it may be assumed that a vessel of this form would possess the advantages of plenty of space for cargo—of stability and swiftness—of being more exempt from taking in seas—of making less lee-way—and of simplicity of mould and construction beyond vessels of the common form.

The great difficulty in moulding a ship is to suit her form to adaptation for both calm and stormy seas; but in a ship of the common form, the shape of the volume of displacement is momentarily varying from the varied curves of the mould, and, consequently, the centre of the volume of displacement is constantly shifting in spaces of considerable magnitude, as the ship lifts, falls, or rolls in her course: and this must ever be the case with a ship of a long, straight keel, whether her bows be sharp or bluff, producing constant and violent strains upon her framework; and these will be proportionately increased by giving additional length and less breadth, with the view of attaining the advantage of swiftness. Now, with the broad vessel of the simple form I propose, the centre of the volume of displacement will be subject to comparatively small changes of centre, and these principally laterally or across the beam, instead of foreand aft, as with the long vessel.

The semicircular bow and stern of these vessels will give commodious stern and forecastle cabin accommodation, or they allow admirable spaces for placing cannon in men-of-war and gun-boats, and cannon-balls would strike in vain any part of the sloping inclinations of the bow or stern, as they would assuredly glance off harmlessly into the sea, whether they struck above or below the water-line; and the gunwale, or the part rising above the deck all round the vessel, could fall back at an angle of about 45°, from which shot would glance off.

To steer these vessels I propose to have two rudders, one on each quarter, to act by simple machinery simultaneously or separately, so that the man who steers shall be in close proximity with the officer on deck: but it is impossible in this paper to enter into these details. The suggestion may or may not be taken up by those who alone can carry it out: the seeds of the idea are cast upon the waters, and happy shall I feel if, in due season, they produce a return. I am, Sir, &c., S. P.

IMPROVEMENT OF SUNDERLAND BRIDGE.

For some time past, the Corporation of Sunderland has been discussing the question of erecting a new bridge, the present structure being considered unsafe. A proposition has been made to the Corporation by Mr. A. M. Dunn, Architect (the son of Mr. M. Dunn, the eminent Inspector of Mines), of Newcastle-upon-Tyne, that instead of pulling down the old bridge, they should permit him to alter it in such a manner as will greatly strengthen it, and make the approaches easier. We give Mr. Dunn's letter, and the engraving which accompanies it, as published in the *Sunderland Herald*, September 1st.

Sir,—I forward to you, along with this communication, a wood engraving illustrative of certain alterations which I have already submitted to the Bridge Committee of your Council, as to the permanent repair of Sunderland Bridge. Every one is aware that the chief danger of the bridge exists in the vibration that accompanies each passage across it. The cause of this vibration, which every day becomes more palpable, is the undulating form of the roadway, which sweeps down from the apex to the haunches on either side in a steep incline, and vehicles rushing up one side and down the other naturally throw the greatest pressure upon the weakest point, namely, midway between the haunches and the apex, and actually *striking*, as it were, the side of the bridge with almost a similar effect as a cannon-ball would have, shaking it from end to end. The desideratum, therefore, is to obtain an *equality* of pressure without imposing any considerable additional weight upon the structure. This I propose to effect in the following manner:—Over each of the present girders I would construct another of a framework of wood, and the spandril filled in with light and elegant metal work similar to the existing ones. The under side will lie on the roadway, fitting close to the curved line, and the upper side will form a gentle incline towards the apex, and on this a new road of timber and asphalte will be constructed. The base of each girder will rest on the solid abutment, into which it will be firmly bolted and tied with iron, the ends meeting at the apex in an iron socket and ridge-piece, thus becoming self-supporting upon the same principle as the timbers of any ordinary low-pitched roof, and by resting gently but equally upon all portions of the bridge, entirely remove the dangerous vibration, and consolidate, as it were, the whole structure, and, I have not the least doubt, render it safe and serviceable for very many years to come. The road would have to be raised, for some little distance on each abutment, some six or seven feet. The merits of the scheme I submit to be as follows:—1st. Removing all vibration by means of an equality of pressure and an easy passage across. 2ndly. The little additional weight imposed will rather have a beneficial than a dangerous effect. 3rdly, and lastly. The facility of carrying out the scheme without interruption to the traffic (half the bridge could be done at once), and at so small an outlay, about £4,000.

Archibald M. Dunn, Architect, Newcastle-upon-Tyne.

P.S.—In addition to the advantages above enumerated, the intended roadway may be so widened as to acquire footpaths outside, as it were, the present bridge, thus leaving nearly the whole of the present width for carriage-road. When it comes to be considered that the present flagging and road material exceed 200 tons in weight, the new construction may be accomplished without incurring the objection of overburthening the existing fabric.—A. M. D.

NOTES AND NOVELTIES.

The New Floating Steam Fire-engine.—A great deal of curiosity has been excited recently among the many thousand passengers over Blackfriars Bridge, by noticing a vessel of some considerable length and breadth lying alongside of Rosier's Wharf, at the foot of the bridge, on the Surrey side, being fitted up with immense furnaces, steam-boilers, and other apparatus. From the singular construction of the hull of the vessel, there being neither wheel nor screw at the stern, many have come to the unanimous conclusion that, when finished, the vessel is intended for some peculiar action in the East. Instead, however, of her being likely to be engaged against the Emperor of Russia, she is to be permanently employed, when finished, against an enemy in this country as alarming, whenever he makes his appearance near the waterside, as ever the great Autocrat is to those who take an interest in the political welfare of the country. The vessel, which was built and launched from Messrs. Mare's yard at Blackwall, is about 130 feet long, and is being fitted up as one of the largest steam floating fire-engines that ever navigated the River Thames. She will be propelled by the centrifugal wheel or pump, which will be in the water, out of sight; and the engines will be able to throw immense streams of water a far greater distance than the present steam-float, which has stood the extraordinary pressure of $107\frac{1}{4}$lbs. (on engines and hose) on the square inch, and has been found to do more execution than several land-engines. As soon as the machinery is put in by Messrs. Shand and Mason, of the Black-friars-road, this powerful engine will be moored off Southwark Bridge; and the one already there will be removed to Rotherhithe, to supply the float worked by manual labour, and stationed there at present. Both floating engines, until a few years since, were worked by hired auxiliaries, one taking 120 hands and the other upwards of 90 to play the levers; but it was found that as the men were paid according to the hours they were employed, and the longer the fire lasted the greater was their remuneration, they made little or no attempts, unless closely watched, to pump the water upon the fire. The Committee of the London Fire Establishment, therefore, decided upon doing away with floating engines worked by men, and substituting in their place powerful steam-working floats.

The "Chasseur" Military Floating Factory recently left the Tyne, where she has been completely fitted out, manned, and stored by Messrs. T. and W. Smith, the shipbuilders, of Newcastle, for employment in the Black Sea. This factory comprises an engineer's fitting-shop, a smithy, a foundry, a saw-mill and carpenter's shop, and has on board mechanics and all the most improved machinery for carrying out each of these branches effectually. There are on board also other useful workmen, including a brickmaker, well-borer, and miner; and the internal arrangements for their accommodation on board are excellently contrived, including a bath-room, ventilation by fan-blast, messing and sleeping galleries, manager's office, and foreman's apartments and factory store-rooms. There is on board a portable engine, shafting, and standards; so that, when occasion serves, a plant of machinery may be worked on the shore. Model huts of wood, canvas, and iron are also sent. It is remarkable that, notwithstanding the capabilities of this novel factory, the whole has been arranged with space and convenience on board of a 70-horse-power iron steamer. The work has been fitted under the superintendence of a committee of Royal Arsenal officers, consisting of Colonel Tulloh and Captain Collinson, of the Royal Engineers, and Mr. John Anderson, the talented engineer and inspector of machinery, with such skill and certainty, that every belt and machine in the factory worked correctly upon the first trial; so that not a single alteration was necessary, and in four working days from the trial the vessel proceeded to sea, manned, victualled, and the factory itself stowed full of iron, steel, wood, and other materials for carrying on its operation on arrival at the Crimea. We hope to be able in our November number to give a specification and a view of the general arrangement.

Cardiff New Docks.—The operations for improving the entrance and removing the immense bank at the new East Dock are being carried on without intermission. The dock just opened is barely one-half of its intended size, but this extension will not be completed until December, 1856. The new dock, as at present opened, is of the following dimensions:—Length of locks, 220 feet; width of ditto, 55 feet; length of basin, 380 feet; width of ditto, 250 feet; length of dock, 1,000 feet; width of ditto, 300 feet. The proposed extension, when finished by the contractors, Messrs. Hemingway and Pearson, will give a total length of 3,000 feet. Two lines of railway will be run to the east side, one from the Rhymney Valley line, and the other from the South Wales; and the west side will be connected with the Taff Vale by branches. The coal and iron shipping machines have been provided.

The Caledonian Canal.—The 50th Report of the Commissioners for making and improving the Caledonian Canal made its appearance a few days ago. The works of the canal sustained the very severe winter of 1854-55 without injury; and the interruption of the traffic was solely owing to the severe frost which prevailed from the end of January to the middle of March, blocking up the canal for six weeks. The principal deficiency now is in the accommodation for the local traffic, and the safe, convenient, and economical maintenance of the canal itself. The revenue of the year has been injuriously affected by the absence of the usual arrivals from the Baltic, in consequence of the war with Russia, and the severe gales of November and December rendered the Moray Firth almost inaccessible. The failure of the potato crop in the northern counties has been another cause of diminution of the spring trade. The income for the year amounted to £6,643, and the expenditure to £7,135. The tonnage of steamers navigating the canal from the 1st of May, 1854, to the 30th of April, 1855, was £28,974; and the dues received on the same, £1,119. The general account of moneys received and disbursed since 1803 gives the receipts at £1,361,704, and the disbursements at £1,360,634.

ERRATA.

In the papers contained in our last Number, relative to Boulogne and its improvements, we omitted to correct a slight mistake in the spelling of the river on which the town stands. This river is the *Liane*, not *Liarre*, as spelt several times in the articles in question. A somewhat similar error has been made in the spelling of the quarry from which the marble of the Napoleon Column was procured. The name of this quarry is *Haut Bane*, not *Haut Barre.*

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 16th May, 1855.

1110. J. Knowles and E. T. Bellhouse, Manchester—Working of marble, stone, glass, &c.

Dated 7th July, 1855.

1523. J. Gedge, 4, Wellington-street South—Photographic glasses. (A communication.)

Dated 10th July, 1855.

1537. F. Loret Vermeersch, Malines—Looms.

Dated 18th July, 1855.

1608. W. C. Thurgar, Norwich—Preservation of the fluid substance of fresh eggs.

Dated 19th July, 1855.

1638. S. Stocker, Brighton—Water-closets.

Dated 26th July, 1855.

1695. J. Beattie, 26, Hans-place, Chelsea—Folding mattress, hut, ambulance, &c.
1697. J. Hunt, New Kent-road—Self-fastening band.
1699. W. Brown, Bradford—Combing machinery.
1701. C. Thompson, South Shields—Prevention of smoke.
1703. C. Goodyear, Avenue-road, St. John's-wood—Gunpowder. (A communication.)
1705. W. Mardon, Christchurch-chambers, Newgate-street—Treating garancine. (A communication.)

Dated 27th July, 1855.

1707. C. Hodges, Manchester—Knitting machinery for hosiery. (A communication.)
1709. P. Effertz, Aix-la-Chapelle—Cutting, creasing, or marking paper, &c.
1711. C. F. Kirkman, Argyle-street, Regent-street—Spinning machinery.
1713. A. Smith, Mauchline, N.B.—Cigar and other cases.

Dated 28th July, 1855.

1717. H. H. Barry, Bedford-street, Strand—Combing and carding machinery.
1719. J. Hyde, Sheffield—Furniture castors.
1721. W. Brownfoot, Leeds—Apparatus for raising or lowering blinds, maps, &c.
1723. E. Willis, King-street, St. James's—Wine-bottles.
1725. C. Goodyear, Avenue-road, St. John's-wood—Covers for floors.

Dated 30th July, 1855.

1727. J. M. Fillier, Paris—Looms.
1729. W. F. Coles, 61, Paul-street, Finsbury—Boots and shoes.
1731. T. Clunes, Aberdeen—Pumps and fire-engines.
1733. J. H. Whitehead, Mowville, Otley, York—Steam-boiler furnaces.

Dated 1st August, 1855.

1741. S. Mellor, Salford, and T. Young, Manchester—Supplying water to steam-boilers.
1743. J. Clarke, Leicester — Machinery for making loop fabrics.
1745. G. Bufnoir, Lyons—Stopping bottles.

Dated 2nd August, 1855.

1747. A. Allan, Perth—Valve-gear.
1749. J. Saunders, Newgate-street—Roller for cloth, &c.
1751. R. Bodmer, 2, Thavies-inn, Holborn—Rotatory steam-engines. (A communication.)
1753. D. Airey and W. H. Lackabane, Paris — Rotary steam-engines.

Dated 3rd August, 1855.

1755. H. H. Watson, Bolton-le-Moors—Coke.
1757. A. E. L. Bellford, 32, Essex-street, Strand—Grinding-mills. (A communication.)
1759. G. H. Fullard, Thorney, Cambridge—Pin for thatch coverings.
1761. J. C. A. Pfaff, Wiesbaden—Motive power.
1763. H. J. Betjemann, 449, New Oxford-street—Extending tables. (A communication.)
1764. C. Ritchie, New Palace-yard, and G. Ritchie, Milbank-street—Cork and other materials for stuffing.
1765. J. H. Johnson, 47, Lincoln's-inn-fields — Metallic waterproof fabrics. (A communication.)
1767. R. Richardson and W. Greenshields, Douglas, Isle of Man—Chenille fabrics.

Dated 4th August, 1855.

1769. H. L. R. Perrot, Chaux de Fonds, Switzerland—Escapement for chronometers.
1771. E. Whiteman, Riverhead, Sevenoaks—Waterproof coats, boots, capes, &c.
1773. E. Hall, Dartford—Gunpowder.

Dated 6th August, 1855.

1774. J. Macintosh, Great Ormond-street — Incendiary materials to be used in warfare.
1775. J. Gedge, 4, Wellington-street South—Motive power. (A communication.)
1777. J. Avery, 32, Essex-street, Strand—Windlasses. (A communication.)
1779. F. A. Wilson, Islington—Portable cooking apparatus.
1781. H. A. Pradel, Paris—Twisting textile fabrics. (A communication.)

Dated 7th August, 1855.

1783. J. Hamnett, Broadbottom, Chester—Shuttle tongues.
1784. C. Bedells, Leicester—Elastic fabrics.
1785. S. C. Lister, Bradford—Hackling and combing machinery.
1786. J. A. Manning, Inner Temple—Treatment of sewerage.
1787. J. H. Johnson, 47, Lincoln's-inn-fields—India-rubber. (A communication.)
1788. G. Nasmyth, Kennington—Preserving animal and vegetable matters.
1789. W. J. Murphy, Cork—Motive power.
1790. W. M. Tileston, 16, Cannon-street—Machinery for ruling paper. (A communication.)

Dated 8th August, 1855.

1791. W. Hopkinson, Huddersfield—Steam-engine boilers, furnaces, &c.
1792. B. W. Pycock, Southholme, Gainsborough—Curtain fixtures. (A communication.)
1793. W. Baron, J. Lang, and H. Liversage, Blackburn—Winding, sizing, and dressing yarns.
1794. N. Smith, Thrapstone—Horse-rake.
1795. J. C. Haddan, Cannon-row—Rifled and other cannon.
1796. R. B. Cooley, Nottingham—Hats.
1797. P. A. Devy, 10, Old Jewry-chambers—Hair fabrics. (A communication.)

Dated 9th August, 1855.

1799. J. Sidebottom, Broadbottom, Chester—Shuttles and skewers for shuttles.
1800. V. Delperdange, Bruxelles—Joining tubes and pipes.
1801. E. Cooke, Balsall-heath, near Birmingham—Moulds for casting metallic furniture.
1802. P. and M. Latour, Paris—Looms.
1804. P. A. Le Comte de Fontaine Moreau, 4, South-street, Finsbury—Feeding steam-boilers. (A communication.)
1805. G. H. Bachhoffner, Upper Montague-street—Advertising.
1806. T. Sleight, Hull—Compound for bowel complaints.
1807. W. B. Adams, 1, Adam-street, Adelphi—Locomotive engines.
1808. J. Robertson, Cask Works, Commercial-road—Casks.

Dated 10th August, 1855.

1809. A. Heaven, Longsight, Manchester—Machinery for embroidering fabrics.
1810. W. Mickle, Willington, Durham—Smelting iron.
1811. W. H. Lancaster, and J. Smith, Liverpool—Gas.
1812. G. Durham, 3, Drummond-crescent, Euston-square, and C. Wyatt, 1, Conduit-street, Regent-street—Machinery grease.
1813. J. Betteley, Liverpool—Ships' chain cables.
1814. E. Finch, Chepstow—Machinery for discharging coals from waggons.

1815. E. Finch, Chepstow — Loading and unloading coal-vessels.
1816. A. Morin, St. Etienne—Artificial fuel.
1817. J. L. Stevens, Fish-street-hill—Steam-boilers.
1818. P. and M. Latour, Paris—Machine for cutting nails and driving into shoe.
1819. P. Lagergren, Stockholm—Paddle-wheels.
1820. G. R. Innes, Valparaiso — Raising and lowering rolling blinds. (A communication.)
1821. E. and W. Ullmer, Fetter-lane—Cutting paper and millboards.

Dated 11th August, 1855.

1822. P. L. P. Baragnon, Paris—Preserving and reckoning coin.
1824. P. Pretsch, Islington—Photography.
1825. J. Gardner, Plaistow—Salt.
1826. C. E. Reeves, M.D., Edward-street, Portman-square—Repeating fire-arms.
1827. W. Brown, 5, Catherine-street, Lambeth—Sheet-metal casks and kegs.
1828. L. Turletti, Paris—Portable alarm apparatus.
1829. A. C. Morrison, 3, Acacia-place, St. John's-wood—Compound for feeding horses, &c.
1830. E. Topham, Nottingham—Cleansing steam-boilers.

Dated 13th August, 1855.

1831. L. Normandy, 67, Judd-street — Circular weaving-machine. (A communication.)
1832. W. G. Gregory, Leeds—Camp furniture.
1833. W. Hancock, Upper Chadwell-street—Casks, barrels, and linings of same.
1834. W. Horsfield, Langley Mill, Derby—Railway axle-boxes.
1835. E. D. and G. Draper, Massachusetts, U. S.—Can for oiling machinery. (A communication.)
1836. R. Blackburn, Wandsworth, and W. L. Duncan, Putney-vale—Bleeching.
1837. T. Butler, Willenhall, Staffordshire—Locks.
1838. A. and F. Thornton, Nottingham—Plushed or piled fabrics for hats, &c.

Dated 14th August, 1855.

1839. T. Kempson, Birmingham—Steam-engine and boiler.
1840. J. Venables, Burslem—Ornamenting articles made of clay.
1841. G. Sanders, Dublin, and R. E. Donovan, Castleknock, Dublin—Gas-meters and steam-boilers.
1842. G. Shears, East-place, Kennington-road—Stereoscopes.
1843. M. Mellor, Hyde, Chester—Self-acting mules.
1844. L. Marion, Paris—Consuming smoke.
1845. J. C. Haddan, Cannon-row—Cannon.

Dated 15th August, 1855.

1846. J. Coghlan, M.D., Wexford—Pivoting artificial teeth.
1847. L. A. Pouget, Paris—Moderator lamps.
1848. S. Statham, Cloudesley-street, and W. Smith, Hoxton—Electric telegraph cables.
1849. G. Napier, Glasgow—Furnaces.
1850. A. V. Newton, 66, Chancery-lane—Railroad chairs. (A communication.)
1851. J. Avery, 32, Essex-street, Strand—Apparatus to be applied to drawers to secure them. (A communication.)
1852. J. H. Johnson, 47, Lincoln's-inn-fields—Reins. (A communication.)
1853. J. Barber, Manchester—Steam-engines.
1854. F. May, Tooley-street—Instantaneous light. (A communication.)

Dated 16th August, 1855.

1855. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Jacquard machines. (A communication.)
1856. J. A. Stocqueller, Regent-street, and W. J. B. Saunders, Southwark—Mechanical means for obtaining elevations.
1857. T. Williams, Liverpool—Breech-loading fire-arms.
1858. C. Joyner, Birmingham—Stopcock.
1859. A. Shanks, 6, Robert-street, Adelphi—Machines for shaping nuts.
1860. F. Paget, Vienna—Penholder. (A communication.)
1861. C. Rowley, Birmingham—Elastic bands.
1862. J. Atherton and W. Boyes, Preston—Looms.
1863. S. Monk, Smethwick—Bricks.
1864. W. and F. B. Fawcett, Kidderminster—Carpets.
1866. W. Maynes, Stockport—Self-acting temples.
1867. W. E. Baker, Cannon-street West—Sewing machines.

Dated 17th August, 1855.

1868. I. J. Danduran, Paris—Driving apparatus.
1869. J. Fenton, Lancaster—Moderator lamps.
1870. D. Brown, Smethwick, and J. Brown, Kingswinford—Bayonets.
1871. G. Collier, Halifax—Weaving plush by power.
1872. T. Edge, Great Peter-street, Westminster — Gas-meters.

Dated 18th August, 1855.

873. E. Heys, Hulme, Manchester—Flyers used in spinning.
1874. W. Sangster, 75, Cheapside—Umbrellas and parasols.
877. A. Savago, Eastcheap—Mechanism for treating tea, sugar, coffee, and chicory.
1878. F. Tavernier, Paris—Combing wool, &c.

Dated 20th August, 1855.

1879. A. R. Le Mire de Normandy, 67, Judd-street, Brunswick-square—Soap.
1880. A. Dubrulle, Lille (Nord), France—Safety-lamps.
1881. A. Bain, Westbourne Park-road, Apparatus for distributing liquids.
1882. F. Journeaux, Mount Shannon Mills, Dublin—Drying grain.
1883. W. Soelman, 3, Bennett-street, Fitzroy-square—Propellors.
1884. W. Avery, Smethwick—Bands for transmitting power.
1885. H. Knighton, Stamford—Portable drill.
1886. P. Goutier, Paris—Treating linseed, poppy, and other oils, &c.
1887. J. H. Brown, 4, Trafalgar-square—Ball cartridges.

Dated 21st August, 1855.

1888. R. Longsdon, Queen-street-place—Removing property into and out of strong-rooms, &c.
1889. G. Lewis, Leicester—Taps and cocks of glass.
1891. J. Cornes, Swan-lane—Consuming smoke.
1892. C. L. A. Meinig, Piccadilly, and F. X. Kukla, Raven-row, Mile-end—Ornamenting surfaces.
1893. J. Orange, Nottingham — Covering yarns or other cores.
1894. L. Paige, Vermont, U. S.—Railway breaks.
1895. E. Field, Drury-lane—Machinery for embossing and colouring.
1896. J. Wormald and G. Pollard, 2, Bridge-foot, Vauxhall—Ratchet braces.

Dated 22nd August, 1855.

1897. D. de Bussac, Brussels—The combination of hydriodic acid, watery or oily, or salts of iodine with tannic acid, the constituting parts of cinchona, or of sarsaparilla, or of the leaves of the walnut tree and iron, or with one or several of these bodies.
1898. C. V. Bergh, Lacken, Belgium—Packing pistons.
1899. M. Blum, Ilzach, Ht. Rhin, France—Hood.
1900. W. Spence, 50, Chancery-lane—Finishing cloth. (A communication.)
1901. J. J. Lownds, New York—Extension pen and pencil case.

Dated 23rd August, 1855.

1903. J. T. A. Zinkernagel, Paris—Mosaic work.
1904. T. E. Wyche, Camberwell—Propelling vessels.
1905. W. Jones, Pendleton — Printing woven fabrics and paperhangings.
1906. C. Clauss, Liverpool—Removing hairs from hides and skins.
1907. V. Fouchier, 39, Rue de l'Echiquier, Paris—Mill-stones.
1908. E. Parod, Paris—Steering vessels.
1909. J. G. Martien, Newark, New Jersey, U. S. — Oxides of iron.
1910. W. Denton, Addingham, Yorkshire—Drawing wool, &c., off combs.
1912. W. Kidman, Poplar—Tillers or yokes.
1913. T. Bartlett, Chambery, Savoy—Machinery for drilling or boring into stone.

Dated 24th August, 1855.

1914. F. S. Archer, Great Russell-street—Photography.
1915. W. Wood, Monkhill, near Pontefract—Pile and other fabrics.
1916. H. Frooms, Manchester—Pianofortes.
1917. W. S. Gooding, Manchester—A tailor's clay-cutter.
1918. T. De la Rue, Bunhill-row—Printing inks.
1919. T. A. Radiguet, Longjumeau—Dynamical apparatus for motive power.
1920. P. Effertz, Aix-la-Chapelle—Bricks, tiles, pipes, &c.
1921. C. Schlickeysen, Berlin—Pipes, bricks, and tiles.

Dated 25th August, 1855.

1922. J. Avery, 32, Essex-street, Strand—Handles for augers, gimlets, &c. (A communication.)
1923. J. Avery, 32, Essex-street, Strand — Apparatus for exhausting and closing vessels. (A communication.)
1924. J. Avery, 32, Essex-street, Strand—Automatic attachments for gates and doors. (A communication.)
1925. J. Avery, 32, Essex-street, Strand—Improvements in sewing machines. (A communication.)
1926. W. Brown, Wandsworth—Paper bags.
1927. C. F. Stansbury, 67, Gracechurch-street—Mill for grinding. (A communication.)
1929. E. Carless, East London Works, Mile-end—Artificial leather.

Dated 27th August, 1855.

1932. F. Rualem, 29, Rue de Paris, à Belleville, France—Fuel for household and general purposes.
1933. C. E. Capron, 4, South-street, Finsbury—An improved cupping apparatus.
1934. J. Woordsworth Robson, 23, Grundy-street, Poplar New Town—Water-closets.
1935. T. A. Cooling, Temple-chambers, Whitefriars—Pumps.
1936. C. Humfrey, jun., 14, Terrace, Camberwell—Fatty and oily acids.
1937. E. C. F. Sautelet, Paris—Impermeable cloth.
1938. J. Smith, Bristol—Perambulator and invalid carriages.
1939. S. Ludbrook, Mile-end—Railway wheels.
1940. W. Johnson, 47, Lincoln's-inn-fields — Rolling or shaping metals. (A communication.)
1941. W. Johnson, 47, Lincoln's-inn-fields—Railway breaks. (A communication.)
1942. C. Humfrey, jun., 14, Terrace, Camberwell—Candles.
1943. C. Esplin, 21, Windmill-street, Lambeth—Gas regulator.
1944. A. V. Newton, 66, Chancery-lane—Separating substances of different specific gravities. (A communication.)
1945. A. E. L. Bellford, 32, Essex-street, Strand—Percussion guns. (A communication.)
1946. B. Moore, New York—Sewing machines. (A communication.)

Dated 28th August, 1855.

1947. J. Hopkinson, jun., Huddersfield—Furnaces.
1948. E. N. Fourdrinier, 22, Percy-circus, Pentonville—Machines for cleaning table-knives.
1949. R. A. Brooman, 166, Fleet-street—Umbrellas. (A communication.)

Dated 29th August, 1855.

1950. J. Booth, Manchester — Machinery for drilling and boring.
1952. C. F. Stansbury, 67, Gracechurch-street—Seed-planter. (A communication.)
1954. C. Radcliffe, Sowerby Bridge — Moistening textile fabrics for finishing.

Dated 30th August, 1855.

1955. J. More, Glasgow—Marine and surveying compasses.
1957. J. Gedge, 4, Wellington-street South, Strand—Casks. (A communication.)
1958. C. F. Stansbury, 67, Gracechurch-street—Plane-iron. (A communication.)
1959. C. F. Stansbury, 67, Gracechurch-street—Changeable lock. (A communication.)
1960. C. F. Stansbury, 67, Gracechurch-street—A machine for splitting leather. (A communication.)
1961. J. Juckes, 18, Baker-street, Islington—Furnaces.
1962. H. C. Jennings, 8, Great Tower-street—Medicine for cholera and diarrhœa.
1964. P. E. Charton, Troyes, France—Metallic manometer.

Dated 31st August, 1855.

1965. W. R. Palmer, New York—Writing-desks.
1966. R. Schramm, 6, Warwick-crescent, Harrow-road — Obtaining oil. (A communication.)
1967. J. Gedge, 4, Wellington-street South, Strand—Kilns, ovens, or furnaces. (A communication.)
1968. G. F. Rose, Birmingham—Lithographic and copper-plate printing presses.
1970. J. White, East-street — Machinery for cutting soap. (A communication.)

Dated 1st September, 1855.

1972. R. W. Winfield and J. Jackson, Birmingham—Metallic bedsteads, &c.
1976. A. I. Austen, Belmont, Vauxhall—Candles and night-lights.
1978. T. Bentley, Margate—Heating water or other fluids by gas.

Dated 3rd September, 1855.

1984. T. J. Larmuth and J. Smith, Salford — Printing machinery.
1986. E. G. Jones, Smethwick—Flattening cylinders of sheet-glass.
1988. W. H. Zahn, New York — Machinery for making covered or plated twist and cord.
1990. H. E. Flynn, Retreat, Ranelagh, Dublin—Communications between guards and drivers of railway trains.
1992. W. A. Gilbee, 4, South-street, Finsbury—Carburetted hydrogen gas. (A communication.)
1994. G. H. Golding, Maidstone, and T. Paine, Blackheath—Boots, shoes, clogs, &c.

Dated 4th September, 1855.

1996. W. Woodcock and T. Blackburn, Over Darwen, and J. Smalley, Blackburn—Pistons.
1998. W. H. James, Camberwell—Steam-engines.
2000. D. G. Foster, Pentonville—Training plants.
2002. W. De la Rue, Bunhill-row — Treating Burmese naphtha.
2004. A. Morel, Roulaix, France—Preparing fibrous materials to be combed or spun.
2006. J. H. Bull, West Farms, Westchester, U.S.—Fountain ink-stands.

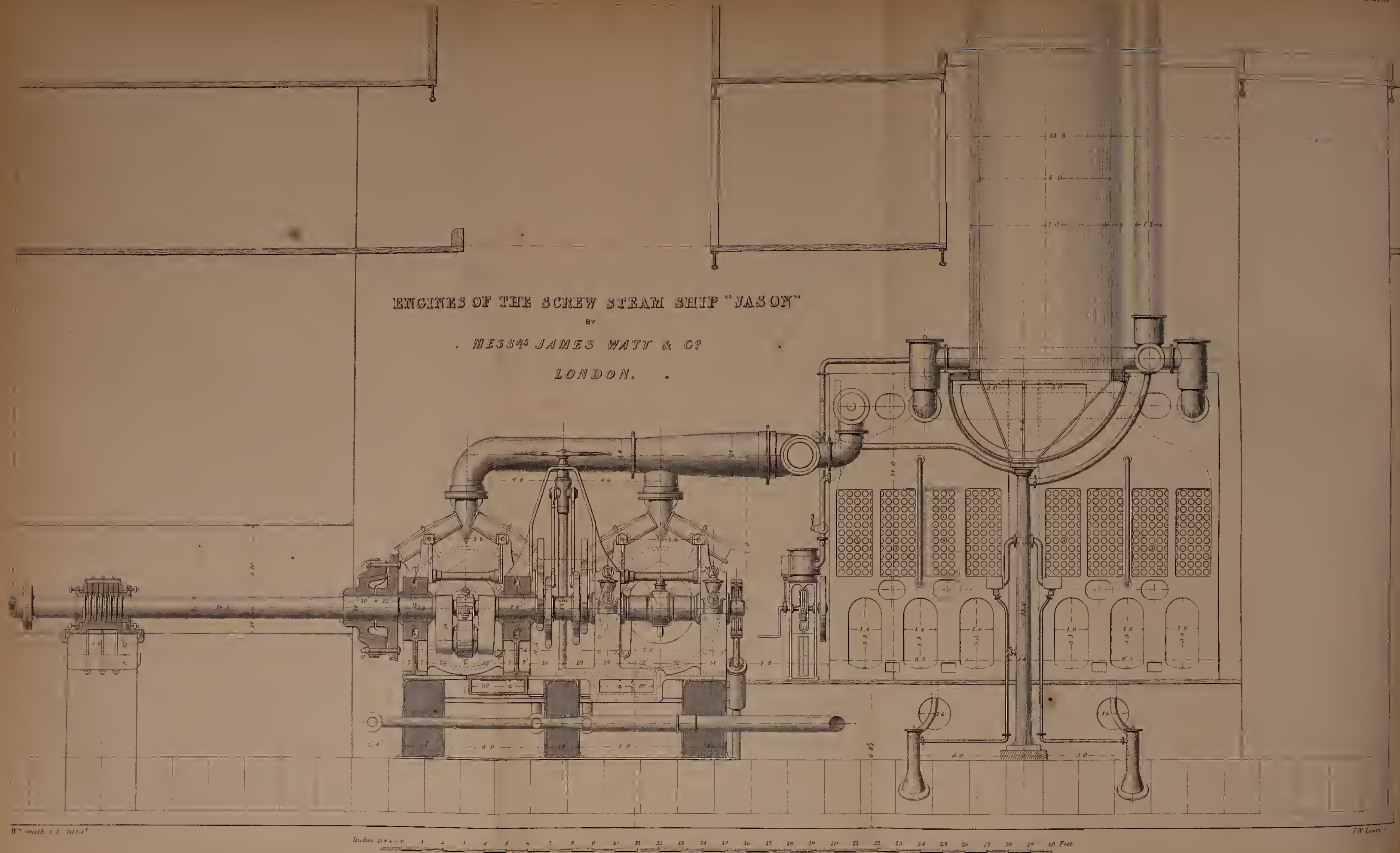
INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1902. W. Pitt and E. T. Davies, Birmingham—Cornice-poles and picture-rods, and in rings and chains to be used in connexion therewith.—22nd August, 1855.
1969. J. and T. Hope, Rhode Island, U.S. — Machine for engraving the surface of a calico-printer's roller, preparatory to its being etched.—31st August, 1855.

DESIGNS FOR ARTICLES OF UTILITY.

1855.

Aug. 23, 3747. Edmund Israel, Milk-street, Cheapside, "A reel."
„ 31, 3748. John Eddy, Kenford, near Exeter, "A plough."
Sept. 3, 3749. Goodall and Son, and Mould and Tod, Camden-town, "Powder envelope."
„ 3750. Dent, Allcroft, and Co., Wood-street, City, "Tilbury glove."
„ 3751. Thomas and Godfrey Binns, jun., Deighton, near Huddersfield, "The expanding envelope."
„ 6, 3752. Joseph Parkes, Birmingham, "Brooch and dress fastening."
„ „ 3753. Hume and Melville, Edinburgh, "Stamp for embossing designs on paper and other substances."
„ 10, 3754. James Eagles and Son, Walsall, "Brush."
„ 11, 3755. Samuel Hemming, Clift House Works, Bow, "Portable economic fireproof building."
„ 14, 3756. Tucker and Son, 190, Strand, "French signal and cooking lamp."
„ 18, 3757. Henry Bird, Stourbridge, "Mouthpiece for cornopeans and other musical instruments."
„ „ 3758. Donaldson, Hirsch, and Spark, 33, Spencer-street, Goswell-road, "Under shirt."
„ 19, 3759. Henry Barry Peacock, 9, St. Ann's-square, Manchester, "Reversible carriage mantle."

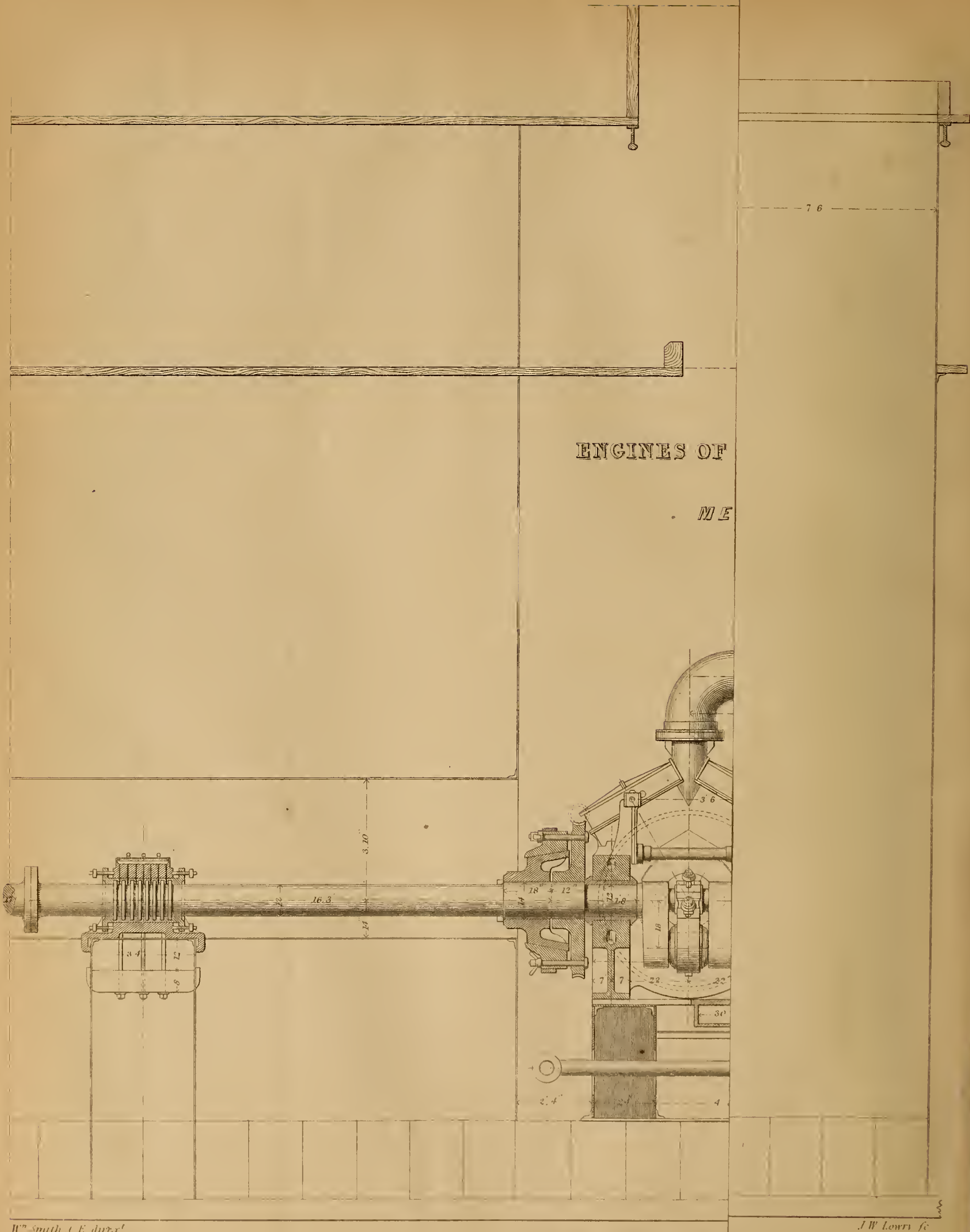


ENGINES OF THE SCREW STEAM SHIP "JASON"

BY

MESSRS JAMES WATT & Co.

LONDON.



Wm Smith, C.E. del.

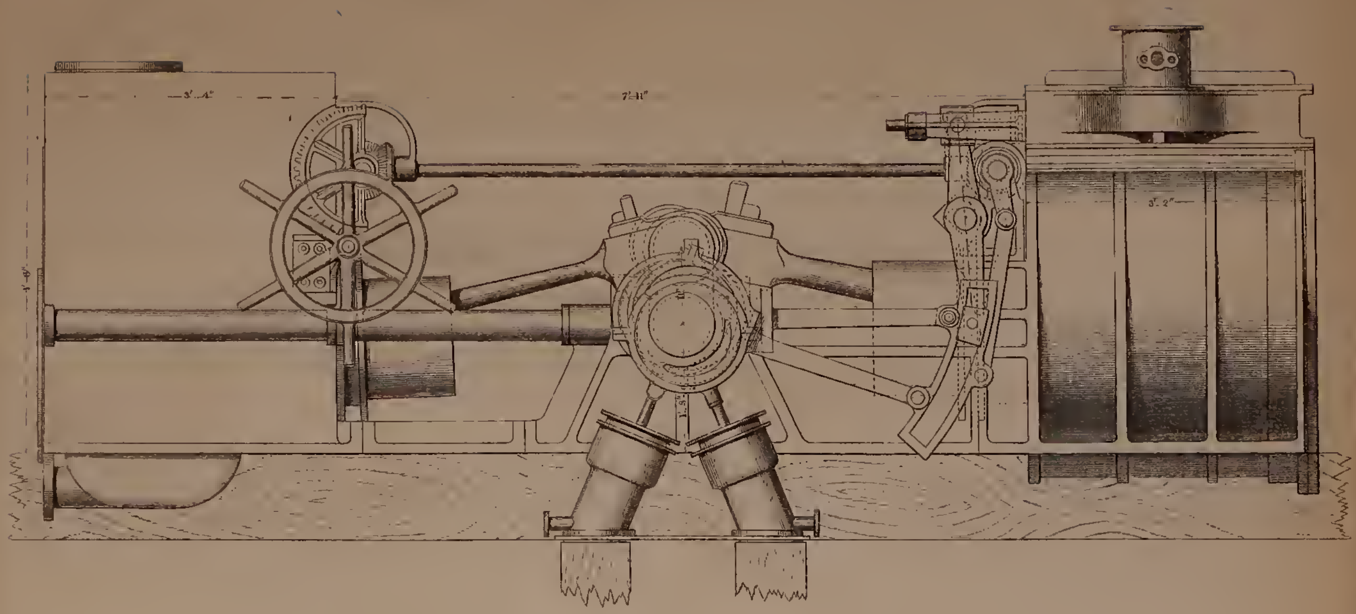
J.W. Lowry, fc.

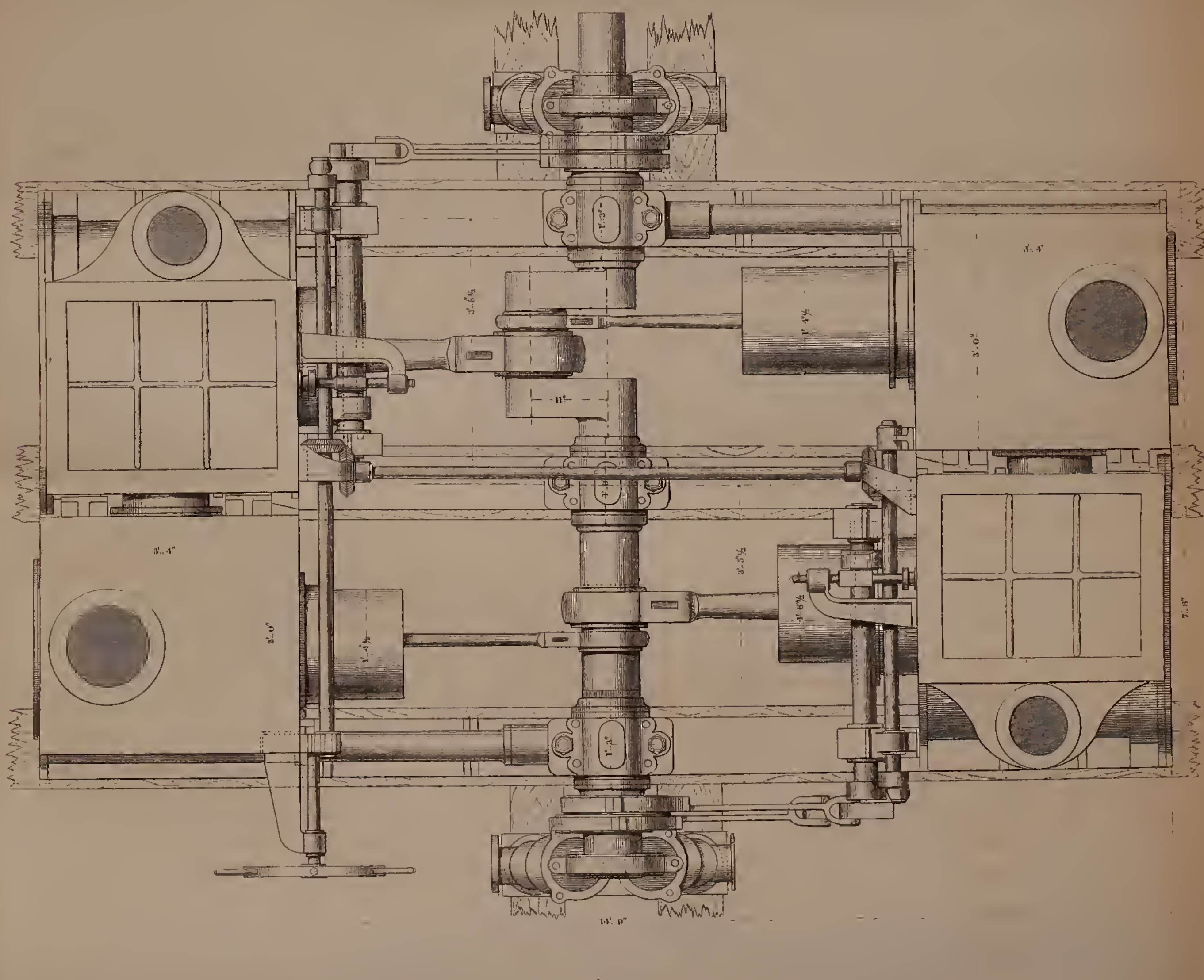
Inches 12 9 6 3 0 1 2 3 4

PATENT DIRECT ACTION ENGINES OF 150 H.P.

FOR THE STEAM SLOOP "VICTORIA"

BY GEORGE RENNIE AND SONS. —— 1855.





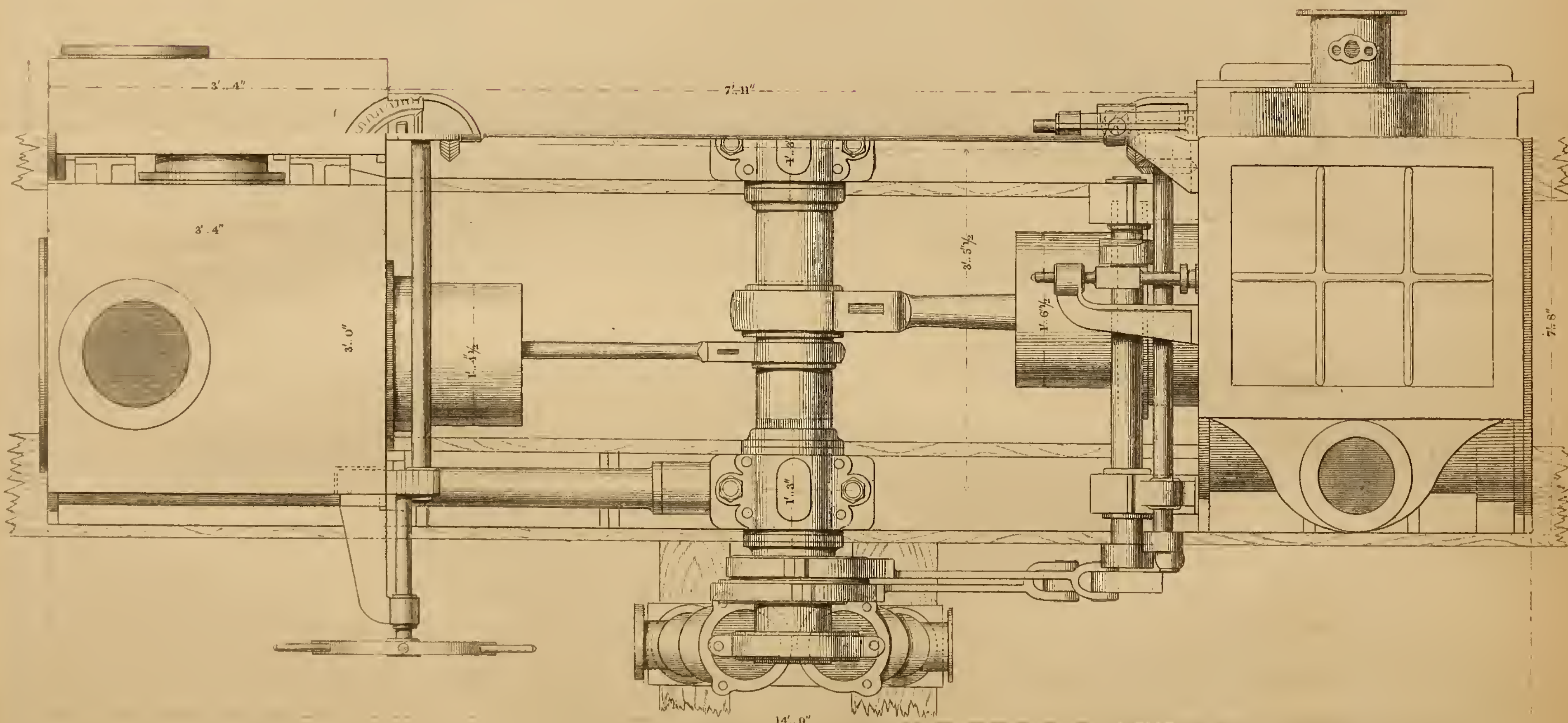
Scale ⅜ to a Foot

W. Smith C.E. Direxᵗ

PATENT DIRECT ACTION ENGINES OF 150 H. P.

FOR THE STEAM SLOOP "VICTORIA"

BY GEORGE RENNIE AND SONS. —— 1855.



Scale ⅝ to a Foot

W. Smith C. E. Delin.t

THE ARTIZAN.

No. CLIV.—Vol. XIII.—NOVEMBER 1st, 1855.

THE PARIS UNIVERSAL EXPOSITION, 1855.

AGRICULTURAL IMPLEMENTS.

When fairly amongst these in the great French Exposition, one is seriously reminded of our own famous agricultural shows. The well-known names of Ransome, Garrett, Clayton, Crosskill, Hornsby, and other English manufacturers, meet us at every step ; and not less familiar to our eyes are the highly-characteristic machines of these great makers, so well known to all the frequenters of the English agricultural shows. We do not propose to dwell at any length on the ordinary agricultural machines, but to pass at once to the implements for reaping, which constitute probably the most important step that has been made for some years in agricultural machinery.

It appears that from the earliest times great importance has been attached to the idea of a machine which should supersede the labours of the reaper of corn and the mower of grass. The want of such a machine was doubly felt, in consequence of the scarcity and dearness of labour at harvest-time, and the necessity for completing in as short a time as possible the operations of the harvest. So long since as the year 1783, the Society of Arts offered a prize for the best mowing-machine ; and this offer was continued, without producing any result, during a period of thirty-six consecutive years.

In this interval several unsuccessful attempts were made to introduce reaping-machines both in England and in America ; and it is said that the father of Mr. M'Cormick, now one of the most eminent and successful makers of the machine which bears his name, had already constructed one as early as 1810. In 1830, the present Mr. M'Cormick began to make experiments, which he prosecuted with such success, that in 1834 he took out a patent for a reaping-machine. To this first patent he added successive improvements in 1845 and 1847, at which time he had brought his machine to a considerable degree of perfection.

Although the American reaping-machines first appeared in England at the Great Exhibition of 1851, a large number had been made in America before this time. We are credibly informed that Mr. M'Cormick, who was originally a farmer in the State of Illinois, supplied 150 machines in the year when he commenced manufacturing. In the second year he turned out not less than 500, while in the year 1850 more than 4,000 reaping-machines were working in the various States of the Union.

At the Exhibition of 1851, there were two American machines which warmly competed for the pre-eminence—namely, M'Cormick's and Hussey's—both machines being named from the inventor or first makers. Each of these machines has still its advocates amongst English farmers ; and whilst one eminent manufacturing house—namely, Burgess and Key—purchased the right of making M'Cormick's machine, another not less celebrated—Messrs. Deane, Dray, and Deane—commenced the manufacture of Hussey's.

The prize of the Jury in 1851 was, however, awarded to M'Cormick's machine. Since that time the rival makers have progressed in popular favour, and a number of other makers have started up, each professing to have introduced some improvement on the original. Among these are M. Cournier, a French manufacturer, at St. Roman's (Isère), and J. S. Wright, an American, who makes a reaping and mowing machine called Atkins' Automaton. Both of these exhibit in the French Exposition. It would unreasonably extend this article beyond the limits intended, if we were to go at any great length into the minute differences between these various machines : we shall, therefore, confine ourselves to a few general remarks.

The first machines consisted essentially of a contrivance for attaching the horses to the reaper, and a driving-wheel, with iron bosses or projections, from which two separate motions were derived—first, the motion of a simple wooden fan, with four arms or vanes to press the crop against the cutting part of the reaper ; and, secondly, a system of wheelwork which gave an alternating transverse motion to the saw-bar of the machine. The saw-bar and knives—or gripes, as they have been called—were fixed in a framework which projected about 6 feet in width on one side of the pole or part of the machine to which the horses were attached. Such were the simple elements of the first reaping-machines.

The modification introduced in Mr. Wright's machine consists of a raking apparatus, which, he says, effects a further considerable saving of labour, and also of a more perfect adaptation of the machine to the purposes of mowing grass.

The chief merit of M. Cournier's machine is the lightness of draught, one horse being capable of working it.

The real question of superiority is yet undecided ; but as a full and complete trial of all the machines entered for competition at the French Exposition has recently been made at Trappes, near Versailles, under the inspection of Prince Napoleon, the decision of the Jury on this occasion may be looked for with some interest.

Steam-Engines for Agricultural Purposes.

The competition produced by the annual meetings of the Royal Agricultural Society, the public trials of engines made every year, and those meetings and the prizes subsequently awarded, have certainly tended very much to improve this class of engine. Not only is the first cost much less, but the consumption of fuel to work them has gradually been reduced, year by year, till these small high-pressure non-condensing engines are now actually worked with a consumption varying from 4 to 7 lbs. of coal per horse-power per hour.

In the present French Exposition there are fixed and portable steam-engines by Ransome and Sims, Hornsby and Son, Clayton and Shuttleworth, and William Dray and Co. The engines of the first three makers, together with that of Messrs. Garrett and Son, stood first in merit among the fifty-six engines tried at the Lincoln meeting of 1854.

The following table contains a comparison between the four best portable engines on that occasion:—

Name of Maker.	Nominal Horse-power.	Time of Working.	Coals consumed per Hour for each H.P.
		hours. min.	lbs.
Hornsby and Son	8	3 4½	4·553
Ransome and Sims	7	2 44½	5·103
Clayton and Co.........	6	2 41½	5·201
Garrett and Son........	6	2 29¼	5·622

The cylinder in Hornsby's portable engine is placed horizontally at the further extremity of the boiler within the steam-chamber.

The chief advantages of this engine were thus pointed out in a report recently made by the judges of the Bath and West of England Society, who had one of the engines taken to pieces for the purpose of examination:—

1st. Great steadiness of motion.

2nd. Simplicity of construction, and good means of adjustment for wear.

3rd. An improved mode of placing the tubes in the boiler.

4th. Greater height in the steam-chest above the fire-box, giving less liability to prime.

5th. Safety-valve not liable to set fast by corrosion.

6th. Facility for withdrawing piston-rods and slides for examination.

7th. Governor worked with great steadiness, and kept the engine perfectly under control.

8th. The cylinder being in steam-chamber, is not exposed to changes of temperature, whereby condensation is prevented, and pressure maintained during the whole stroke.

The price of Hornsby's portable engine of 4 horse-power, including boiler and fittings, is £180, or £45 per H.P. The price per horse-power gradually diminishes up to 10-horse-power, the cost of which is £295, or £29 10s. per horse-power.

Ransome and Sims's Portable Engine.

In this engine the cylinder is placed above the boiler, and at the further extremity. The boilers are made in a superior manner, and tested to a pressure of 100 lbs. per square inch.

The makers supply a 5-horse-power engine, including waterproof cover, tube-cleaner, fire-pricker, rake, screw-hammer, oil-can, a large funnel, and spare gauge-glass, for £190, or £38 per horse-power. The 10-horse engine is £275, or £27 10s. per horse-power, and intermediate sizes in proportion.

Ransome and Sims's Fixed Steam-Engine.

This engine, which obtained the first prize at the Lincoln meeting in 1854, is of the description termed horizontal direct-acting, and can be fixed either on a stone or brick foundation, or carried on two wooden sills. In the boiler of this engine, the fire is placed in an internal circular flue, and the flame passes through and along each side of the boiler to the chimney. The setting of the boiler is perfectly simple, and can be done by any ordinary bricklayer. The cylinder is placed horizontally; and the piston-rod, which works between guides, gives motion to a cranked axle, on which is fixed the fly-wheel, used also as a driving-wheel.

Messrs. Ransome state that one of their 8-horse-power fixed engines will drive three pairs of 3-feet-8-inch millstones, the usual calculation being about 4 horse-power for each pair of 4-feet stones. The small cost of these engines, the readiness with which they may be attached to ordinary millstones in wind and water mills, and the certainty and regularity of their performance, have caused them to be very extensively used by millers who wish to insure regularity and economy in their business.

The prices quoted by Messrs. Ransome for these engines include the boilers, but not the cost of the connexion between the boilers and the engines, as this varies according to the distance at which they are placed asunder.

They supply a 4-horse engine and boiler for £150, or £35 per horse-power; and a 12-horse engine for £270, or £22 10s. per H.P.; and intermediate sizes in proportion.

Clayton and Shuttleworth.

1. *Portable Engines.*—The improved form of engine made by this firm has the cylinder placed horizontally in a steam-tight jacket, and the whole enclosed in the smoke-box and under the chimney at the front of the boiler. The makers claim great advantages from this arrangement, which entirely prevents radiation of heat, and causes the cylinder to be permanently in a temperature of about 400°.

Their price for a 4-horse engine of this construction is £180, or £35 per horse-power; for a 14-H.P., £420, or £30 per horse-power; and in the same proportion for intermediate sizes. They also supply an outside cylinder engine at somewhat reduced prices.

2. *Fixed Engines.*—These, like Ransome's, are erected on a metal foundation-plate, have horizontal cylinders and cranked axle, on which the fly-wheel is placed.

This engine is very similar in all its details to that of Messrs. Ransome and Sims's, already described. The prices quoted also include the same extras.

The 4-horse-power engine is charged £130, or £32 10s. per H.P.; and the 14-H.P., £360, or £26 14s. per horse-power. Other sizes in proportion.

Garrett and Son appear to have no steam-engines at the Exposition. They have confined themselves to threshing-machines, drills, and other implements, for which they are justly celebrated.

W. Dray and Co. exhibit a fixed steam-engine, direct-acting, with a vertical cylinder—a somewhat different construction from the other fixed agricultural engines.

Their 6-horse-power engine obtained the second prize of the Royal Agricultural Society at the Lincoln meeting.

The cylinder of this engine is 8 inches diameter, with a 14-inch stroke. The crank-shaft is of wrought iron, 3 inches diameter, and makes 90 to 100 revolutions per minute. The fly-wheel is 71¼ inches, or nearly 6 feet in diameter; weighs 8½ cwt., and can be used as a driving-pulley. The boiler is 10 feet long, 3 feet 3 inches in diameter, and made of best Staffordshire plate, ⅜ inch thick; rivets, ⅝ inch diameter, and 2 inches apart. It is fitted with a 3-inch safety-valve, water-gauge, blow-off cock, furnace-door, dead-plates, fire-bars back-bridge, flue-doors and damper, and an apparatus for heating the feed-water. These engines, with boilers complete, are supplied at £104 for a 3-horse-power, or nearly £35 per horse-power. The price per horse-power diminishes for larger engines; so that a 30-horse engine costs, complete, only £580, or little more than £19 per horse-power. Intermediate sizes in proportion.

The portable engines of Dray and Co. have outside cylinders on the top of the boiler, near the hind extremity. Their prices are, for 4-horse-power, £165, or rather more than £41 per horse-power; for 12-horse, £310, or £26 per horse-power; and other sizes in proportion.

Great pains have evidently been bestowed on the agricultural part of the Exposition, a separate building being devoted for the display of implements and models. In one part of this building is an example of draining according to the English method, with the trenches laid open, and tubular 2-inch pipes, with collars, laid in them. The tools used in executing the work are placed by the side, and every pains have been taken to render the system clear to the intellect of France.

Besides all the usual collection of agricultural implements, there are one or two objects of peculiar interest. One of these is a very fine display of bees and bee-hives, and having the insects under glass, and accompanied by large anatomical models of bees and honeycomb on a large scale, showing every detail of structure in a very interesting manner.

There is also a very fine collection of coleopterous or beetle-winged insects, divided into two great classes, one of which is useful, the other injurious to agriculture. The useful ones prey on worms and other pests of the farmer. Among the useful forms are most of the grass-hoppers and ladybirds. The grasshoppers feed on several of the injurious insects, and the larvæ of the ladybirds destroy aphides and several small-winged insects which feed on plants. Generally speaking, these insects, which live on vegetable food, and whose habit is to perforate the seeds, stalks, and leaves of plants, are said to be injurious; while, on the other hand, the carnivorous insects, which prey on the vegetable feeders, are considered useful to agriculture.

MODELS OF BRIDGES, VIADUCTS, AND OTHER LARGE ENGINEERING WORKS.

Model of the Pontiffroy Bridge, over the Moselle, at Metz, $\frac{1}{25}$th of the full size, showing the method commonly adopted in widening the French bridges.—The bridge was originally about 22 feet wide between the parapets, built with semi-elliptical stone arches of 35 or 40 feet span, with projecting starlings. In widening the bridge, the piers have not been extended, but prisms of masonry have been carried up on the projecting cutwaters, so as to support elegant arcs in front of the old elliptical arches.

Several of the bridges over the Seine in Paris have the roadway supported by substantial stone arches, springing near the water-level; while the footpath on each side is carried by a light cast-iron girder, springing at a much higher level, from prisms of masonry erected on the cutwaters of the piers. This kind of bridge has an elegant appearance, and costs less than when the arches of masonry extend through from side to side.

Model of the Viaduct of Bouzanne, on the Railway from Châteauroux to Limoges, on a scale of $\frac{1}{25}$.—This viaduct is more than 100 feet high, and consists of semicircular arches, supported on piers, 10 feet wide at the springing and 16 feet at the base.

Model of the Opening Aqueduct for passing the Torrent of the Libron over the Canal du Midi.—This is a peculiarly interesting work, the level of the stream crossing the canal being such that it can neither be carried under or over without interfering with the navigation; and hence the necessity for having a form of aqueduct which at ordinary times carries the stream at its proper level across the canal; while, in order to provide for the uninterrupted navigation of the latter, there are means of stopping the stream and opening the aqueduct like a common opening bridge, in order to allow the free passage of vessels. We are not aware of any similar work on any canal in Great Britain.

The following are the principal dimensions:—

Opening of canal where it passes beneath the aqueduct ...	24 feet
Height from bottom of canal to under side of aqueduct......	10 „
Depth of coffer or aqueduct carrying the stream across the canal........	10 „
Width of coffer or aqueduct	8 „

On each side of the canal is fixed a horizontal lifting-leaf, and a sluice across the brook-course, which stops the water when the aqueduct is required to be opened. The following is the process of opening:—The sluice on each side of the aqueduct is shut down; the leaf adjoining each sluice and between the sluice and the canal is then raised into a vertical position, by the ordinary apparatus used in lifting bridges. Then one-half of the aqueduct slides back into a recess at right angles to the canal, and thus opens the passage. Each half of the coffer or actual aqueduct is suspended by three rods on each side, from a strong framework erected over it. At the top of each rod is a small flanged wheel, about 20 inches diameter, which runs on an iron rail. Thus, each half of the aqueduct is in fact a suspended carriage, running on six wheels; so that the friction is reduced to so small an amount, that the separate parts are easily moved backwards and forwards.

Model of a Viaduct over the Durance, on the Railway of the Mediterranean.—A handsome structure, built of stone. The exterior elevations of the arches are flat segments of circles, contracting inwards to semi-elliptical arches, about 50 feet in span. This bell-shaped form of arch, which has a very bold and striking effect, is much practised in France, and may be seen in several of the bridges over the Seine, and also in Mr. Telford's famous bridge over the Severn at Gloucester, which was built on the model of one of the French bridges.

Model of the Pont d'Asnières, carrying the St. Germain's Railway across the Seine, built by M. Flachal, Engineer-in-Chief of the Railway. This is a tubular iron bridge, having five rectangular beams of iron, formed of boiler-plate rivetted together. Each beam is about 7 feet deep by 1 foot 9 inches wide, and the bridge carries four lines of rail.

A Lifting-bridge without a counterweight, constructed over the navigable River Lawe, in the department of the Pas de Calais, by M. Davaine, Engineer-in-Chief and M. Quaisain, Acting Engineer.—The span of the bridge, which has only one leaf, is 36 feet, its width 20 feet, and height above the bottom of the river 20 feet. The bridge is raised by a double-powered wheel and pinion. In the first power, the ratio of the teeth in the pinion to those in the wheel is about 1 to 4. In the second power, a pinion of 10 teeth works into an arc of 120°, having 54 teeth. Hence, the power gained by the double system of wheel and pinion is about 20 to 1. Bridges on the same principle as this, with equal if not larger openings, have been constructed in this country, at Hull and elsewhere.

Viaduct of Dinan, constructed to carry a road of the first class over the River Rance, a few miles above St. Malo; from the designs of M. Reynaud; superintended by Messrs. Miguel and De Gayffier, Engineers-in-Chief, and M. Fessard, Acting Engineer.—The arches are semicircular, each about 50 feet in span; and the extreme height of the aqueduct is about 120 feet.

Pont Napoléon, a double bridge, carrying a road and a railway, side by side, across the Seine, at Bercy; constructed by M. Courtin, Engineer-in-Chief, and M. Petit, Acting Engineer.—The arch is a flat segment of a circle, 112 feet in span; and the road and railway over the bridge are each 25 feet in width.

The Aqueduct of Roquefaveur, constructed by M. de Montvicher, over the River Arc, to convey the waters of the Durance to Marseilles.—This magnificent work has two tiers of semicircular arches, one over the other, supported on piers of immense height; and over these two equal tiers, each about 100 feet high, there is a third row, of less height. The extreme height cannot be less than 250 feet; so that we have here a work which rivals the famous Pont du Gard, constructed, near Nismes, for a similar purpose, by the Romans during their occupation of this part of France. The appearance of this great aqueduct of Roquefaveur is strikingly bold and magnificent. In all the lower part of the work, the stones are only dressed on the beds, joints, and round the edges; the exposed face of the stone being left rough, to resemble rockwork. The piers are carried up to their extreme height, dressed in this manner; the only parts dressed to a smooth face being the spandrils of the arches, and the front elevation of the upper tier of arches.

Another model shows the centering used for the arches, which are semicircular, and 50 feet span. The centering consists of four strong ribs, and the arch stones were set by means of powerful travelling cranes.

The Pont d'Arcole, now in course of construction over the Seine at Paris, from the designs of M. Oudré, Engineer of Bridges and Roads.—This bridge has a single arch of 260 feet span, and is nearly 70 feet wide between the parapets. The roadway is supported by ten wrought-iron curved beams, and the footpaths by one each, placed at a greater distance from the others than those which support the roadway. The footpaths are each nearly 12 feet wide.

LIGHTHOUSES.

The Minister of Agriculture, Commerce, and Public Works for France has added to the attractions of the Exposition by sending the revolving part of a lighthouse of the first order. The lenticular plates of glass which surround the light are chiefly cast at St. Gobain. Lighthouses of the fourth order, with fixed lights, and several others, are also exhibited.

Another beautiful katadioptrical apparatus of the first order, with eclipses each minute, has been constructed for the United States of America, intended for a lighthouse in the Gulf of Florida, and is exhibited in the nave of the Palace. This is a revolving light, with lenticular rings of glass arranged in the form of an octagon.

Messrs. Chance and Brothers, of Birmingham, exhibit the top of a lighthouse recently constructed by them. This is a dioptric light of the first order, with katadioptric zones.

CANADIAN FIRE-ENGINES.

As at the Great Exhibition of 1851, Canada makes a great show of fire-engines, which are said to be of very superior construction in Montreal, Quebec, and other principal cities of that country. Among the best fire-engines at the present Exposition is one by Perry of Montreal. This engine has the fore-carriage moveable entirely round, so that the engine can be turned without difficulty. The body of the engine is all of copper, varnished and painted in a superior manner; the wheels are handsomely made, with polished brass naves, &c The cylinders are two in number, fixed in a sloping or inclined position, one on each side of the air-vessel, with which they communicate. The cylinders are 5 inches in diameter, with 11-inch stroke; and the engine in an ordinary way is worked at the rate of about 47 strokes per minute, but may be worked up to 56. It is usually worked by 12 or 14 men, and is said to throw several quarts of water per man per minute more than most other engines of its own size. Mr. Perry professes to have introduced an improvement in this engine by the use of what he terms a suction air-vessel, which is a small upright cylinder closed at top, and connected with the hose; so that air which would otherwise accumulate in the hose, and prevent the effective action of the engine, ascends into this second air-vessel, and does not interfere with the working. The price of the engine, with 24 feet of suction-hose, is about £150 currency, or £125 sterling.

The hose is made in a very superior manner, with copper rings inside, and two thicknesses of leather separated by a layer of composition. The makers of these engines say that the leather hose used in England is highly objectionable, because it is often porous and admits the air, which interferes very much with the suction, otherwise with the vacuum into which the water should rise before being acted on by the plungers of the pumps. They are also very particular to avoid turns or bends in the communication between the hose and the air-vessel.

There are one or two fire-engines by French exhibitors, and several by Messrs. Merryweather of Long-acre.

MISCELLANEOUS MACHINES, AND APPARATUS OF VARIOUS KINDS.

In the 12th section of Class 6, comprising special machines applicable to certain branches of industry, the lathes and chasing engines exhibited from Switzerland are well worthy of attention. The beauty and delicacy of the workmanship in the watches manufactured in Switzerland have long been the subject of general admiration in other parts of the Continent. Here we have three beautiful chasing-lathes exhibited, for producing the beautiful waved appearance on the backs of watches, from the workshop of Messrs. Darier Brothers, of Geneva. Two of these are for circular chasing, and are marked for sale at 1,750 francs and 1,150 francs respectively. The third is for straight-line chasing, the object to be operated on having a vertical up-and-down motion, instead of a circular one. The price of this is 1,050 francs.

M. Ducomeau, of Ofen, in the department of the Lot and Garonne, exhibits a good and simple machine for breaking stones, concrete, and other hard substances. The machine acts by hand; the object to be broken being placed on an iron frame, the breaking-weight being a hammer of several pounds. The hammer is moved by hand; but the force of the blow is immensely increased by the action of a common coil spring which is attached to it underneath. Some specimens of very hard basaltic and other stones were readily broken at each stroke of the machine, which never failed, whilst we witnessed it, to perform its work satisfactorily.

A Machine, marked 5,000 francs, or £200, for making all kinds of boots and shoes.—The apparatus consists of a circular iron table, at which are ten separate vices, or holding-places, at each of which a workman is to operate. The performance of the machine is said to be from eight to ten pairs of shoes by each man, per day of ten hours.

The list of minor machines exhibited for all sorts of purposes would fill a volume, and not carry much information after all.

Amongst them are machines for corking bottles, for preparing slates, for making paste and dough; a great number of sawing-machines, envelope folding machines, Finzel's sugar-making apparatus, pumping-engines; machines for sawing wood, for sawing and polishing stone; Jacquard looms, spinning and weaving machines of all kinds, and a host of others for saving and diminishing labour in every form.

Machines for Engraving or Copying Busts or Medals in Marble.

Two machines, the one French and the other American, are exhibited at work for this purpose, and specimens of the work performed by them have excited much admiration. As the principle of both is essentially the same, one description will answer for both machines. The medal or bust to be copied revolves with a circular motion, and so does the piece of marble which has to be fashioned. An iron bar carries at one extremity a sort of blunt instrument, which presses on the surface of the medal or bust; and at the other it carries a cutting tool, which acts on the marble. The machinery is so contrived, that every irregularity of movement communicated to the blunt instrument at one extremity by the undulations in the surface of the medal or bust is also communicated to the cutting tool at the other extremity of the bar, so that this acts in a corresponding manner on the marble. The cutting tool is capable of adjustment on the bar, so as to produce copies bearing fixed proportions to the size of the original; but in both cases the machines in action were producing copies of much smaller size than that from which they were copying.

Turbines.

Several of these machines are exhibited, and they appear to be in favour as a driving-power for millwork in France. Messrs. Fromont, Fontaine, and Brault exhibit the whole machinery of a corn-mill worked by a turbine, and give their prices as follows:—

	Francs.
Mechanism of the mill, with 5 pairs of stones	15,000
The turbine (*système Fontaine*) of the power of 20 horses, with 6½ feet fall..	5,000
The furniture and fittings of 5 pairs of stones, 4 feet 3 inches diameter	3,500
Other machinery of mill, for dressing, winnowing, &c....	8,000
Total	31,500 fr.

Or about £1,260 sterling.

Appold's Centrifugal Pump.

This is exhibited by Messrs. Easton and Amos, with several improvements which they have introduced themselves. It is well adapted for pumping a large quantity of water with a low lift. The duty of this pump is said to be 68 per cent. of the power expended, and the duty increases as the lift diminishes; whereas other pumps discharge only their contents, however small the lift.

Machine for cutting the Grooves in French Millstones.

This is a simple instrument, consisting of a chisel fixed at the end of an arm attached to a cranked axle, worked by hand. This apparatus can be put in any position, so as to cut grooves in any required direction. The distance of the chisel on the arm is capable of being lengthened or shortened as required, so that the frame carrying the arm has only to be shifted for each separate groove; that is, each separate groove requires a different position.

In the open air, outside the Palace, is placed a piece of machinery from Great Britain, which at least excites astonishment on account of its size, if not for other more remarkable qualities. This is Deane's patent turnplate for a locomotive engine and tender. The turnplate itself is 40 feet in diameter, and has three concentric circles of edge-rail, which support a 40 feet length of Barlow's rail. This length of rail revolves on the circular rings, so that an engine and tender can be turned off at any point of the circle. Over the middle ring are placed two crabs, for giving motion to the platform. The platform is warranted to support 40,000 kilogrammes, or about 40 tons. Price 7,500 francs.

Several other turnplates, of smaller size, are exhibited.

In the space outside the building is a heterogeneous collection of large objects, such as full-sized yachts, horse-powers, anchors, threshing-machines, summer-houses, green-houses, conservatories, weigh-bridges, &c. &c.

(*To be continued in our next.*)

ON SCREW-MACHINERY CONSTRUCTION.

In continuation of our remarks, in last month's Artizan, on the means employed for taking the end-thrust of screw-shafts, we would again observe, that we have often to regret, when called upon to inspect new constructions in screw engineering, that the manufacturers have paid but little attention to the subject of future repairs, notwithstanding the enormous extent of this description of engineering work which has been executed in Great Britain within these last two years, and the many important variations in the arrangements of parts for the greater compactness, and, in some cases, greater working efficiency effected; as also in the increased pressure of steam introduced in the Royal Navy, and various other matters which we have from time to time reviewed.

Somehow or other, there has been an almost total disregard of that consideration of details connected with the provision of facilities for examination and repairs, and too great a disposition to crowd together parts, without due regard to such requirements. It cannot be that young and inexperienced men are now directing the operations of our old-established firms, whatever may be the case in many new establishments which have sprung up more recently to supply the vastly increased and increasing demands of our steam marine, and although it may also be the case in some of the establishments whose reputations have been acquired in making engines for locomotive and manufacturing purposes, but have recently, for the reasons just stated, entered upon marine-engine making.

Upon the minds of those directing establishments of the latter classes more particularly, we would strongly urge, as we have often before, the necessity for extreme simplicity, compactness of parts, adequate strength; correctness of the working parts, rather than high polish on the non-working surfaces; proper consideration of how defects are to be made good, accidental derangements corrected, the ordinary wearing of the working surfaces rendered easy of adjustment, and the parts necessary to be removed easy of removal; finally, that ready and safe access be attainable to all the working parts whilst the machinery *is in motion.* These are, we believe, the *desiderata* in all such works of construction, and in screw engineering more particularly.

In illustration of the foregoing remarks, we may mention that very recently we were called upon to inspect a pair of screw-engines, for which a patent had been obtained, "For effecting Improvements in the general arrangement." We certainly found the engines novel and compact in the arrangement of the parts; but we also found, on examination, that one engine had to pass its whole power through an over-hung pinion; also, that one of the main bearings of the shaft could not be got at until the engines were stopped, and then could only be approached by wading on all-fours, through dirty bilge-water. Moreover, we found the screw-alley so confined and boxed up, that to get at the stuffing-box in the stern of the ship, we had to don a pair of overalls, and creep under the shafting a distance of nearly a hundred feet. Now, such arrangements must be patent as monstrously absurd.

Engineers in charge of such machinery, however zealous they may be, are but men; and unless reasonable facilities are given them for the supervision of the working parts of the machines under their charge, we need not be surprised if accidents occur; for in the ship, the engines of which we have just alluded to, although she had made a passage from England to New York, neither of the engineers had ever seen the stern stuffing-box.

Purchasers and owners of steam-ships are beginning to be aware that the value of steam machinery is not to be estimated alone by its first cost, but it is becoming better understood that such machinery shall be able to sustain a given amount of hard work, and have the facilities for repairs properly provided for; for when a large ship is manned, and the current expenses going on, it becomes a matter of serious importance, whether her repair can be effected in so many days, instead of as many weeks. And, considering the various circumstances under which accidents to marine machinery occur, the comparatively few ports out of England at which the large class of steam-ships built at the present

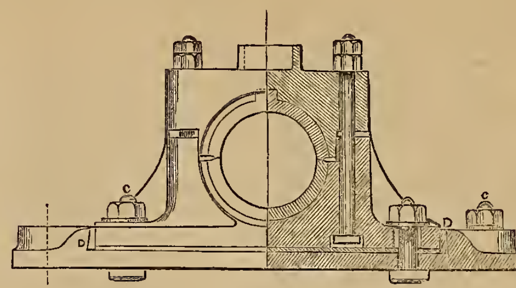


Fig. 2.

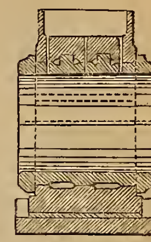


Fig. 4.

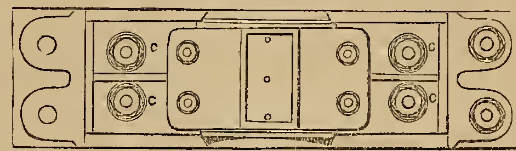


Fig. 3.

Fig. 5.

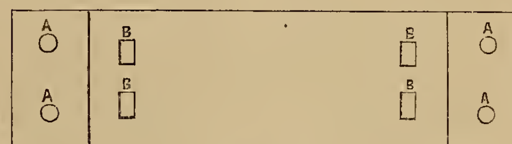


Fig. 1.

day can be docked, or where there are facilities for repairing engines or boilers, the importance of the subject of providing against accidents, and for the re-instatement of defective parts of marine machines, will fully present itself, and excuse our alluding at such length thereto.

The subject we have selected for illustration, although a very simple one, still is important in connexion with the present paper; and in continuation of the remarks upon the means employed for taking the end-thrust of screw-shafts in our last, we propose now to illustrate the pedestal for a screw-alley.

In designing a pedestal for the screw-shaft, we propose—Firstly—That it be made sufficiently strong in all its parts, perhaps in excess of strength over the ordinary rules for calculating the strength of cast-iron pedestal blocks, because for this purpose there are strains and alterations of position which in land-engines for manufacturing purposes have not to be provided for. Secondly—Its working surface should be such as to prevent abrasion: and here we may remark, that, from experience, we have found in the pedestals for shafts, for simply transmitting power, that a brass having a length equal to one and a half times its diameter is about the best proportion. Thirdly—The pedestal should be constructed with facilities for adjustment, vertically and transversely. And, fourthly—That the lower brass should be made so as to be readily taken out and replaced without lifting the shaft. And we hope to be able to show that all this can be done with less cost to the engine-maker than in many similar fixings where no attention has been paid to such provisions.

Fig. 1 is a view of the under side of a pedestal base-plate, it being turned bottom upward. The round holes, A, are for the holding-down bolts: such bolts should be either through bolts having cotters, or with nuts; or they may be secured with proper wood screws. (Of such we will speak hereafter.) The slot-holes are for T-headed holding-down bolts, by which the pedestal block is secured to the bottom plate.

Fig. 2 is an elevation of a pedestal fixed on the base-plate. The wood liners are made to slip over the bolts, and can be taken out by slackening the nuts C C, and may either be reduced or thickened as required for vertical adjustment; and as the slot-holes in the pedestal are made at right angles to those in the base-plate, they allow of transverse adjustment, by means of the keys or end packing piece, D. This figure is shown partially in sectiou, for the better exhibiting the slot-holes, bolts, packings, and the modes of adjustment.

Fig. 3 is a plan of the pedestal block and base-plate.

Fig. 4 is a cross section of the same. The inside of the pedestal block is bored out, and the outside of the brasses turned. The top brass has two nipples or tongues, also round and turned, and their recesses in the cap bored out to receive them. The bottom is without any tongue or nipple, so as to admit of its being turned round in its seat, and whilst the shaft is in its place. Thus, whether it be for the purpose of examination, or for replacing a bottom brass when worn out, there is no necessity for lifting the shaft; for the bottom brass cau be as readily removed when the cap and top brass are taken off, as can ordinarily be done with the top brass alone. The whole of the parts of this pedestal may be fitted and finished by machines alone.

Now for a word on a really good wood screw, or wood holding-down bolt, the want of which we have often felt, and such a one we have shown at Fig. 5.

PUBLIC ENTERPRISE IN CANADA.

It is refreshing to perceive that, notwithstanding the depressing effect of the great war which is raging between the chief European nations, the spirit of enterprise is not wholly quelled on the other side of the Atlantic. The American papers are filled with accounts of one of the most magnificent projects of ship canal navigation that has ever been conceived. This is no less than the connexion of the great central lakes of North America, and the fertile tracts of land which surround them in the far-west, with the great ports of Montreal, Quebec, New York, and the whole eastern sea-board of America. A great struggle is just commencing between Canada on the one hand, and the United States on the other, as to the mode in which this conuexion is to be made. In order to understand the nature of the question which is agitating our Canadian provinces at the present time, it will be necessary to glance for a moment at the great geographical features of the American Lake district—those vast corn-producing districts which form the upper basin of the St. Lawrence.

The three great lakes of Central North America are, Lake Superior, Lake Michigan, and Lake Huron: they cover an area of 93,000 square miles, or nearly double that of all England; and are bounded on one side by the fertile provinces of Upper Canada, and on the other by the State of Michigan and the territory of the Chippeway Indians. The centre of this great Lake district, which is capable of growing corn and timber for the supply of the whole world, may be said to be situated in a straight line about 900 miles west of Anticosti Island, at the mouth of the St. Lawrence. This mighty River St. Lawrence, for more than 500 miles of its course—namely, from the sea up to the junction of the River Ottawa above Montreal—lies wholly in Canadian territory, while beyond this point, through Lake Ontario, Lake Erie, Lake Huron, and Lake Superior, it is bounded on one side by the United States, whose energetic citizens have covered its surface with their steam-boats, and pushed their traffic into its very highest waters. The United States appear especially to possess a monopoly of the traffic on the two lower lakes Ontario and Erie, which are more properly expansions of the river than the much more extensive upper lakes. Although it be literally true that a communication does exist between the upper and lower lakes, and thus, by means of the St. Lawrence, and the great system of canals and railways in the United States, these upper lakes are brought into connexion with the States, yet the communication is so imperfect and circuitous, that the people of the United States are now proposing a great ship canal from Lake Huron to Toronto, so as to divert all the trade of the Lake district into the St. Lawrence through Lake Ontario. On the other hand, the people of Canada, jealous of the St. Lawrence being so much in the power of the United States, are desirous of connecting the great lakes with the western sea-board by means wholly independent of that part of the St. Lawrence which is bordered by the United States. They propose to effect this by a canal passing through Lake Nipissing, and a series of other lakes between Huron and the River Ottawa, which lies wholly in Canadian territory, and can easily be made navigable from the point where the canal would join it, until it falls into the St. Lawrence.

The advocates of this project present it to the Government, and to their fellow-citizens interested in the prosperity of Canada, with strong arguments in its favour. They urge it as the means of rapidly settling and bringing into cultivation vast tracts of fertile country around Lake Huron, destined ere long to supply the worn-out nations of Europe with food. They dwell much on the fact, that the United States project would divert most of the produce into their own territory, as much of it would probably leave the St. Lawrence by the many canals and railways which communicate with Lake Ontario. The Ottawa route, on the contrary, would be wholly in the hands of the Canadians, and free from any interference or interruption in case of a war or other rupture with the United States.

It appears that the Ottawa route has been already partially examined and reported on, and that two lines have been suggested, in oue of which about 25 miles of artificial canal would be necessary, and in the other about 35. The River Ottawa itself consists for the greater part of extensive reaches of dead water, from 15 to 16 miles in length, lying one behind the other, and forming so many steps ascending from Montreal to Lake Nipissing:—of course, the rapids between these reaches of level water would have to be surmounted by locks or other contrivances. The Ottawa route would save 500 miles between Lake Huron and Montreal, as compared with the present United States route through Lakes Erie and Ontario; a saving which would be at once sufficient to draw all the western traffic into the St. Lawrence—an effect which has not been at all produced by the present circuitous navigatiou.

There are few people not conversaut with Canada who have any idea what a magnificent river is the Ottawa. It has been compared to the Rhine in length of course, and to the Danube in magnitude, while its volume is equal to double that of the Ganges in ordinary seasons. Its channel at Bytown is half a mile in width; and above this town, which has lately changed its name to that of the river itself, it receives tributaries equal to the Hudson, the Shannon, the Thames, the Tweed, the Spey, and the Clyde. The valley of the Ottawa is equal in extent to eight times the whole State of Vermont, or ten times that of Massachusetts.

It is said that the project of the Ottawa route between Lake Huron and Montreal is not new, but that twenty years ago it engaged the attention of British capitalists. At that time, the prairies of Illinois, Wisconsin, Iowa, and Minnesota were little more than Indian hunting-grounds, and the population of Canada comparatively small. The scheme was not attended to, owing to the political troubles which followed, and was allowed to fall to the ground; although the Company which was then formed sought only a certain extent of land adjoining the river as a compensation for their outlay of capital. Since that time, the Canadian provinces have nearly doubled their population; the western prairies have swarmed with inhabitants, and cities of 50 and 60,000 people have sprung up on the shores of Lake Michigan. Since that time, also, vast sums of money have been laid out on the St. Lawrence by the Canadian Government: this, unfortunately, has hitherto produced little effect, *because the Americans have given the commerce of the lakes a shorter route* to the sea-board through the State of New York. The purely Canadian project, however, which we are here discussing, would undoubtedly divert all the western traffic iuto the properly Canadian part of the St. Lawrence.

The United States project has been called the Georgian Canal, because it commences in Georgian Bay, the south-eastern part of Lake Huron. It is estimated by the advocates of this scheme, that the traffic will amount to four million tous of goods a year, to be conveyed from Chicago, Milwaukie, and other places on the shores of Lake Michigan. The advocates of the Canadian project estimate their traffic at even more than this, and observe, that if the Georgian Canal is made to the exclusion of the Canadian route, all this immense amount of traffic will be diverted into the United States, to feed the Erie Canal and other navigations which communicate with Lake Ontario. We cannot conclude these remarks better than by the following extract from the *Ottawa Tribune*, which seems to sum up most of the arguments in favour of the Canadian project, and touches on one or two points which we have not hitherto noticed:—

"There is an evident advantage in the Ottawa route over all others. It cannot be topped by any rival route, it has no competitor; it would be emphatically a Canadian work; and if Canada is ever to be a uation, this is necessary as a national work. The Rideau Canal is a failure as a military work—the St. Lawrence could not be used in war-time—the peninsula of Canada would, in the event of war, be left to the protection of the few vessels which the Kingston Dockyard could send out—the Lake cities would be at the mercy of an enemy. But, provided with an internal ship channel, and a strong naval depôt at the mouth of French River, we could maintain a connexion between the great lakes and Quebec, which would enable us to command not alone Michigan, Huron, and Superior, but also the lakes below—would enable us to be as troublesome on Lake Michigan as the enemy might be on Erie and Ontario. The fact is, that the only line of defence to be maintained, would be to secure the safety of this route, the weakest portion of which would be 50 miles from the frontier. Our Grand Trunk Railway passing along the St. Lawrence would be perfectly useless, and by this route alone a proper connexion with Quebec could be kept up. The fact of such a work being at our command might go far to insure the blessings of peace to Canada; for the Western States would see their interest in keeping on amicable terms with our country.

"Our present defenceless condition is pitiable to contemplate. Even while we talk of rifle and artillery corps covering the land, a strong American force thrown on our shore above Brookville would cut the western peninsula wholly off from the source of its military supplies in the eastward; while we could send any amount of men and supplies by the Ottawa route, if we had only our Lake arrangements well matured. The Ottawa is properly the backbone of Canada, peopled as it should be, and could be, if Government did it justice. We require population, however, and here is a field for it. The vast territory north and south of the Ottawa, rich in soil and minerals, invites the emigrant to a comfortable home. The forests of timber brought by the Ottawa Canal into contiguity with the great western prairies, would create an immense milling business on every waterfall between this and Lake Huron; the mines of metal throughout the same region would employ a large population; altogether one or two millions of people would locate on both sides of the river in course of time; and the greatest step to advance this consummation is the realisation of the project we are now discussing."

BOILER EXPLOSION AT THE KEBBLESWORTH COLLIERY.

The frequency of steam-boiler explosions seems to betray the alarming fact, that there is something we do not yet understand in the action of the powerful agent which is now so universally employed by man in all his concerns, from the conversion of the fragile fibres of a worm into yards of silk, up to the propulsion of immense steamers whose burthen is measured by thousands of tons. And we have to regret that there is no source to which we might refer for an exact record of all the facts of these unhappy occurrences, from which it might be possible to eliminate beyond a doubt the attendant coincidences, and thus be enabled to apply a universal safeguard. At the Kebblesworth Colliery there were five ordinary cylinder boilers, fed by branches from a single feed-pipe, and supplying in a similar manner one steam-pipe. Each boiler was furnished with two safety-valves, properly regulated to open at a pressure of 35 lbs. on the square inch, to which the strength of the boilers was amply adequate. The level of the water was indicated by a float balanced over a pulley, which arrangement was represented as one that "seldom goes wrong when well looked after." The attendant was remarkable for care and steadiness, and was 23 years of age. One of the boilers exploded on the 19th of September last, and was torn into three pieces, one of which with the unfortunate man was blown nearly 200 yards. It was in evidence at the inquest, that the boilers had been lying idle during the previous two hours, with insufficient fires to make any extraordinary amount of steam; that two of the feed-valves were open; and that there was reason to believe the attendant had discovered there was a deficiency of water in the boilers, and was endeavouring to rectify the evil by opening some one of the valves of the boiler which at that moment exploded. We have here the extraordinary fact placed before us, of an explosion taking place in a boiler having a certain connexion with four safety-valves, and probably with the ten of the entire set, and the disaster occasioned by the means provided for its prevention. Had the pressure gradually accumulated, it would have betrayed itself unmistakeably through some of the countless joints, rivets, and seams, even had all the valves been blocked, before a decided rupture was occasioned; and if the falling of the water had simply caused the exposed plates to become weakened by the action of the fire, the effect would have been a rupture at that place only. Submit any combination of material arranged for the purposes of strength to a constant strain, and it will give way at its weakest point; it would be shattered only by a sudden blow. A cannon strong enough for its duty under ordinary circumstances, may be blown into pieces by not ramming home the ball. It is reasonable, then, to suppose the explosion at the Kebblesworth Colliery was not occasioned by a pressure of steam, allowed steadily to accumulate until it exceeded the strength of the boiler. The united plunging and kicking of the hundred horses representing its power, would at once tear asunder a cable amply strong enough to withstand their mere draft force.

Various propositions have been advanced to account for the instantaneous generation of power within a boiler. We know that electrical phenomena may be exhibited by the agency of a jet of steam blown into the open air, and that the different capacities for heat of various substances may be used to generate electricity, known as thermo-electricity; but we cannot imagine a steam-boiler based freely in communication with the earth converted into an immense Leyden jar. The generation of explosive gas, too, has been again and again suggested as a cause of explosion. The steam has been decomposed by the heated plates, the oxygen absorbed by the iron, and the hydrogen left to explode. That the affinity of iron for the oxygen of surcharged or superheated steam does operate to a limited extent, we possess evidence of in the wasting away of the braces and internal surface of the steam-space of old boilers, but not to a degree sufficient to make any appreciable change in the chemical composition of the steam. Besides, hydrogen is not explosive unless mixed with common air, which has no access to the interior of a boiler with an internal pressure exceeding its own. An external explosion might possibly be produced, but certainly not an internal one.

Before advancing an opinion as to the progress of events which resulted in the explosion at Kebblesworth, we would briefly advert to surcharged steam, and to foaming or priming.

Water conveys heat by circulation; a quantity of it may be heated by applying the heat to its lower part, the particles in contact with which rise and convey their heat to the colder particles above them, which descend in turn to become heated and pass along in the current of circulation. Its conducting power is so small, that heat applied to the surface will raise the temperature of the upper stratum alone. Heat applied to steam will increase its temperature and pressure at the same rate it would those of amospheric air, or any other gas; which rate is considerably below that of water or other liquid. Steam at the pressure of the atmosphere has a temperature of 212° Fahrenheit; and when it receives 500 degrees additional heat, has its pressure doubled. Water, however, at the comparatively low temperature of 435°, to which the experiments of Arago and Dulong were extended, forms steam exerting a pressure of *twenty-four* atmospheres. Although not critically exact, as it does not embrace all the circumstances, which for the sake of simplicity have been omitted, the proportion indicated above exhibits the momentous weight of this consideration. That steam may be heated in contact with water without also heating the water, we have not a doubt, and is instanced by a case which, some time since, fell under our attention. A boiler had been filled with water from its tank, situated 3 feet above the top of the internal flues, and the pipe left open. After starting the fire, steam was formed, the water forced back into the tank until it fell below the opening of the feed-pipe, which was 6 inches below the top of the flues; the plates exposed to the fire were heated, and bent down, but *not fractured;* and the steam heated sufficiently to burn the felt and wood covering the top of the boiler, although there was 3½ feet of water remaining in the boiler. It is worthy of note in this example, that the pressure could not have exceeded the few pounds due to the column of water in the feed-pipe. It may be conceded, then, that steam can be raised to a high temperature in contact with water without affecting the safety-valve or pressure-gauge to a corresponding degree; and also, that if water were mixed with this superheated steam, the excess of heat would be abstracted for the conversion of the water into steam of a pressure due to the temperature of the water. When the steam from a boiler carries a portion of water with it, the boiler is said to foam or prime. One cause of foaming is the too rapid abstraction of steam from the boiler, and the sudden relief of the surface from pressure, causing the steam to lift the water with which it is rising from the heating surface. If the relief is partial, or from a comparatively small opening in a large boiler, the rush of steam and water to the point of relief is excessive. The water will always stand higher in a boiler while the engine is in motion, and may be further raised by opening the safety-valve. With a *safety*-valve, then, or by starting the engine, the water may be thrown into the superheated steam, and a pressure generated too great for the strength of the boiler, and operating, moreover, with all the momentum of a blow. The means provided for safety may thus become an instrument of destruction.

In summing up the facts of the explosion at the Kebblesworth Colliery, we have two boilers with an open water connexion, one of the fires probably somewhat more vigorous than the other, forming steam of one-half pound higher pressure, and forcing the water-level 12 inches lower in that than in the other, and exposing the flues and surcharging the steam to a high temperature—say 1,000° as a possible limit—without raising its pressure to the 35 lbs. necessary to open the valves. In this dangerous condition, it attracts the attention of a careful and experienced attendant, who naturally rushes to the safety-valve, and, like applying the match to a mine, flashes the water into the steam: an explosion ensues, and the huge boiler is converted into an immense rocket.

S. WORSSAM AND CO.'S IMPROVED MOULDING MACHINE.

(Illustrated by Plate lvii.)

Description.—A is the bed-plate, over which the stuff to be moulded is moved forward by the feed-rollers, B B. The bed-plate, A, can be raised or lowered to suit any thickness of the material, not exceeding 5 inches, by turning the hand-wheel, C, keyed to the end of the screw, D. This screw works in a corresponding thread in the hollow casting, E, to the top of which the bed-plate, A, is bolted; the hollow trunk, F, forming at the same time a guide for the casting, E, and a powerful support to the frame-work of the machine. The two adze-blocks, G G, working in white metal bearings, revolve at the speed of 3,000 revolutions per minute, and are fed by the rollers, B B. The feed varies from 8 to 25 feet per minute, according to the work required. The bearings of these adze-blocks are lubricated by means of two oil-cups, II, II. In the upper adze-block are fastened moulding-irons of any required pattern, up to 9 inches wide. In the lower adze-block are fixed plain irons for finishing the bottom side of the mouldings, or moulding irons for cutting double mouldings or sash-bars—a 9-inch board being thus cut up into finished sash-bars at one operation. In this machine the feed-rollers, B B, are much larger than usual; and as both are driven, the regularity and certainty of the feed are greatly increased. Motion is given to the rollers B B from the speed-pulley I, driving the speed-pulley K, and thence from the two small gut-wheels, L L, to the wheels M M. These wheels drive the pinions and spur-wheels, N N N N, one pair of which work the top and the other the bottom feed-roller. The gut for the bottom roller passes over the sheave O, to allow of the bed rising and falling without altering the length of the gut. The top feed-roller is held down by the gun-metal thumb-screws, marked P, inside of which are spiral springs to regulate the pressure required. By this arrangement, the roller is enabled to rise and fall to suit any irregularity in the stuff or the level of the moulding. A similar arrangement is made for the bars Z Z, and roller Y, for holding the mouldings down: these are marked P′. S S are two riggers for driving the top and bottom adze-blocks, the bands passing over the tightening pulleys T T, the whole being driven by the rigger V. The frame-work of this machine is of cast-iron, and is held down to the floor by the bolts X X.

THE ENGINES OF THE "JASON."

We have the pleasure of being able to present to our subscribers this month a Double Plate, showing a longitudinal section of the engine-room, exhibiting the engines, boilers, and screw-shaft, with its thrust-block.

The engines and boilers were manufactured by the celebrated firm of James Watt and Co., Soho, and fitted by them, at Blackwall, on board the steam-ship *Jason*, of 2,500 tons, the property of the General Screw Steam Shipping Company.

The *Jason* was built by C. J. Mare and Co. at Blackwall, and was launched upon the 6th of August, 1853. She is of iron, having improved stern-posts and keels, and otherwise built according to the plan patented by Messrs. Mare and Co.

Upon the present occasion we shall but give the principal dimensions of the *Jason*, and a few dimensions and particulars of the engines, leaving for a future opportunity some further remarks, and the particulars of her performances, &c.

The dimensions of the ship are as follows:—

Length between the perpendiculars	280 feet 0 in.
Do. of keel for tonnage	254 „ $2\frac{3}{8}$ „
Breadth „ for do.	43 „ 0 „
Depth of hold	31 „ 6 „
Draught of water (when loaded) about	20 „ 0 „
Burthen in tons	$2{,}500\frac{7}{94}$.

The boilers were originally made in six pieces, which would have given sufficient steam to work full power at 18 lbs. per square inch; but, at the request of the owners, who desired to increase her capacity for the stowage of fuel, two of the pieces were removed, leaving four pieces, and, consequently, her nominal horse-power was rated at 300, although, as will be seen below, her engines are really of 400 horse nominal power;

The dimensions of the engines being as follows:—

Diameter of the cylinder	0 feet 64 in.
Stroke of piston	3 „ 0 „
Speed—strokes per minute	50 „ 0 „

Thus giving 300 feet = 400 H.P.

The air-pumps are 9 inches in diameter, having 3 feet stroke, and are double-acting. The slides are double, or two to each cylinder. The screw is on Maudslay's patent swivelling plan, cast entirely of brass; has two blades; is 16 feet 9 in. in diameter, and 3 feet 7 in. long on the blade, with a pitch of 30 feet: it is fitted with a T head, and may therefore be lifted up to the deck when required.

The screw-shaft is driven direct, being coupled to the crank-shaft by a cone coupling; the thrust being taken beyond the coupling, and on the first length of shaft, by a thrust-block with eight rings; and the second length of shaft is connected to the first by means of flanges bolted together.

The speed of this ship, when tried at the measured mile, and deeply laden for the Crimea, was found to be nine knots per hour; and the performance of her machinery was then and has remained perfectly satisfactory, doing no discredit to the eminent firm by whom the engines, boilers, and machinery were designed, manufactured, and fitted.

We propose in our next number to give a second Double Plate of these engines, exhibiting a plan which will fully convey the general arrangements of the parts.

THE SCREW STEAM-FRIGATE "VICTORIA."

In The Artizan for September we gave the dimensions of this frigate, but, by an oversight, printed the dimensions of the screw-propeller as if of a paddle-wheel steamer; but the diameter of the screw is 10 ft., the length of blade 2 ft. 10 in., the pitch 15 ft.; number of blades, two.

In the present number we present our subscribers with a Double Plate, showing two views of the engines of the *Victoria*, of which the following are further particulars:—

The engines were designed and built by G. Rennie and Sons, on their patent direct-action principle, each cylinder and its condenser and air-pump being placed on either side of the main shaft, arranged with the cylinders and air-pumps alternated, so that the pull and thrust upon the screw-shaft is equalised; and one of the advantages found as appertaining to this arrangement of the condensers being close to the cylinders is, that a better vacuum is insured.

The diameter of the cylinders is	0 feet 41 in.
Length of stroke	1 „ 10 „
Number of revolutions	82.

There are two boilers; the stoke-holes being placed "fore and aft."

The general dimensions given at pp. 22-3 are otherwise accurate.

The *Victoria* is built on the diagonal principle of Mr. O. Lang, and was launched from the building-yard of Messrs. Young, Son, and Co., of Limehouse. She has been ordered in this country by the Colonial Government, and is the first instance of our Australian colonists providing themselves with maritime protection; for she is completely fitted as a man-of-war sloop, and does equal credit to the designers and constructors of the ship and engines.

The boilers of this vessel were not required to be kept below the load water-line, the draught of the vessel being 11 ft. 6 in.; although, by a recent improvement in marine boilers, Messrs. Rennie and Sons have succeeded in constructing boilers for vessels of very shallow draught, from which the steam can be drawn perfectly free from the risk of priming over, and by which they are enabled to insure the steam being delivered into the engines in a superheated condition, and thereby effecting economy of fuel.

The Admiralty Authorities have insisted upon having the boilers below the water-line in almost every instance, even in the new gun-boats, which have only 6 to 7 feet draught of water — much to the detriment of the proper working of the engines; yet we do not remember that there is an instance on record where even a paddle-wheel steamer has had her boilers hit or damaged by shot in action; and the present respectable range of our steam-ships' ordnance enables them to keep well out of reach of the guns of forts and other armaments to which they have been opposed, thus reducing the chance of either engines or boilers being struck or injured by any but vertically-falling shot, which would cause damage whether the boilers were above the water-line or below it.

We are truly glad to find that Messrs. Rennie and Sons are not alone maintaining the reputation which they have acquired during so many years of useful labour in the branches of practical science to which they have devoted their abilities, but are making rapid strides towards approaching the highest place in the list of successful marine engineers. They have fitted with engines, on the same principle as those of the *Victoria*, the steam-ships *Victor Emanuelli* and the *Comte de Cavour*, both for the Sardinian Steam Navigation Company, and which have recently been employed in the French Transport Service, and performed most satisfactorily.

They are also fitting two pairs of similar engines in two vessels of 800 tons each for the Guarda Costa Service of the Mexican Government, to which they are also applying their new low boilers, with the arrangement for preventing priming.

NOTES BY A PRACTICAL CHEMIST.

Iodo-nitrate of Silver.—This substance, the active principle in the collodion photographic process, has been found to be a definite compound of the iodide and the nitrate of silver, its composition being represented by $AgO, NO^5 + AgI$. It is blackened on exposure to light much more rapidly than either of its ingredients alone. It is unaffected by and insoluble in absolute alcohol, but is decomposed by water. Its proper solvent is a concentrated solution of nitrate of silver. It may be obtained in regular crystals. Photographic silver baths which have been for some time in use always contain a portion of this compound, the reason of their superiority to those more recently prepared.

Chloride and bromide of silver do not yield similar double salts, which explains why negative photographs on bromide of silver alone are deficient in intensity.

Nitrate of Silver Stains.—These stains may be removed by a solution of 8 parts perchloride of mercury and 4 parts sal-ammoniac in 125 parts water, or one of 5 grms. cyanide of potassium and 50 centigrms. iodine in 45 grms. water.

Behaviour of sparingly Soluble Salts with Alkaline Carbonates.—Sulphate of lead, like those of strontia and lime, is decomposed and converted into carbonate of lead by solutions of alkaline carbonates and bicarbonates, even at common temperatures. The solutions of the neutral carbonates dissolve a little of the lead. By means of solutions of the bicarbonates, sulphate of lead may be quantitatively separated from that of baryta.

Carbonate of lead is not converted into sulphate by solutions of alkaline sulphates at any temperatures.

Chromate of baryta is decomposed by neutral alkaline carbonates at common temperatures, but more rapidly on boiling. The presence of a neutral chromate of alkali prevents this reaction.

Seleniate of baryta is completely decomposed by alkaline carbonates.

Oxalate of lime is also completely decomposed, except an alkaline oxalate be present. Carbonate of lime cannot be completely converted into oxalate by boiling with oxalate of potash. Oxalate of lead is completely decomposed by an alkaline carbonate, even at common temperatures.

Artificial Alcohol.—According to Marx, this discovery, recently put forward by Berthelot, was made twenty-seven years ago by Hennell, who, in the Philosophical Transactions for 1828, p. 365, says: "by combining olefiant gas with sulphuric acid, we may form sulphovinic acid, from which we may obtain at pleasure, by varying the circumstances of decomposition, either alcohol or ether." The method of performing this experiment now recommended is to pass common coal-gas through sulphuric acid, and then to add water in excess.

ANSWERS TO CORRESPONDENTS.

"Verax."—The production of animal life by means of chemical or electrical processes is exceedingly dubious. The chances of error from animal ova or cryptogamous sporules being present in some of the materials, or being introduced from the atmosphere, are so great as to affect most seriously the value of an apparently successful experiment. Without at all joining in the vulgar abuse bestowed on the late Mr. Andrew Crosse, we suspect that his results were vitiated by some incidental source of error, and that the *Acarus Crossii* was not created, but merely hatched by the electric current. As for the alleged discoveries that from time to time figure in the non-scientific papers, our Correspondent will do well to suspend judgment till they have been duly verified.

"Q. T."—To make a bronzing fluid for guns, take nitric acid at sp. gr. 1·2; nitrous ether, alcohol, and chloride of iron, each one part; and mix them with two parts blue vitriol, previously dissolved in ten parts of water.

REVIEWS AND NOTICES OF BOOKS.

Muspratt's Chemistry applied to Arts and Manufactures. (Fourth Notice.)

Under the article Caoutchouc, we have a very good instance of the high value given by modern science to a substance at first regarded merely as a curiosity. Little more than a century has elapsed since this body was first imported, and for a long time it had no other application than the humble function of removing pencil-marks; and now it enters into the most varied manufacturing operations, besides being absolutely indispensable in the laboratory. The trees which furnish this important resinoid are various, the common lettuce, the poppy, and the euphorbium containing a trace in their milky sap; but the great supply of commerce is obtained from the *Ficus elastica* of India, and the *Jatropha elastica* of South America. The former is a magnificent tree, one hundred feet high, and sometimes seventy-four in circumference. From all these trees it is obtained by making incisions in the trunk and main branches whence exudes a milky liquid, miscible with water, but not with turpentine or naphtha. By heat, or by the addition of hydrochloric acid, or a soluble chloride, pure caoutchouc is separated as a white semi-transparent body. The black appearance of the ordinary South American samples is due to their exposure to the smoke of a wood-fire. Pure dried caoutchouc is soluble in oil of turpentine, benzol, and caoutchoucine. Ammoniacal gas, we are told, after a prolonged action restores it to its native state of an emulsion. Its elasticity may be destroyed, or at least suspended, by continued tension—a circumstance taken advantage of in preparing textile fabrics from caoutchouc thread. A remarkable feature is the combination of caoutchouc with sulphur, the result being a definite chemical compound, well known as vulcanised india-rubber. The combination is effected by kneading the caoutchouc and sulphur together by the aid of proper machinery, and afterwards exposing the whole in close vessels to a temperature of 300° F. This temperature is not applied till the article has been moulded into the shape intended, since after heating its adhesiveness is destroyed, and it is no longer affected by the ordinary solvents. So intimate is the union, that the sulphur has not yet been properly removed. Caoutchouc is also combined with pipe-clay, carbonate of magnesia, &c., where great rigidity is desired. Coal-tar and bitumens, vegetal or fossil, have also been incorporated with vulcanised rubber.

At a temperature of 600° F. caoutchouc is volatilised, and re-condenses as a dark oily liquid, *caoutchoucine*, a most valuable solvent for crude india-rubber, as well as for many resinous matters.

We purpose resuming our analysis of this work in our next.

Railways, their Capital and Dividends, &c. By E. D. Chattaway.—John Weale, High Holborn. (Being a second volume of Mr. Stephenson's Work on Railways.)

This work, though small in size, contains a considerable amount of information upon most points affecting the economy of railway working The data which Mr. Chattaway has with some difficulty obtained from various railway companies has been dealt with carefully, and is presented in tabulated forms, which can readily be understood and applied to any other case.

After dealing with railway statistics, the author glances at the subject of railway accidents, and the various means proposed for preventing them. Various signals are described, and the desirableness of a perfect system of communication between guard and engine-driver is forcibly insisted upon; but as railway companies have not yet adopted any thoroughly practical and economical plan, although Symons' patent—which is, we believe, the only really efficient and cheap means of effecting a perfect communication—has been tried experimentally on the Brighton Railway, yet we hope to see the legislative enactment which nearly passed last session become law, rendering it imperative upon railway companies to adopt an efficient apparatus on every railway train. Various other contrivances for railways are described, such as buffing apparatus, breaks, &c.; and this little work concludes with a comparative statement of the costs of some English, American, and Continental railways, their working expenses and receipts: and in allusion to the New York and Erie Railway, the author states—

"The working expenses of this line are upwards of 51 per cent., and its loan capital bears the high rate of interest of 7 per cent., while the receipts are £328 per mile, per annum, less than the average receipts of the lines in England and Wales; yet, after defraying its onerous obligations, it is enabled to pay its shareholders the liberal dividend of 7 per cent. annually. This railway owes its favourable position solely to its having been constructed at a moderate outlay. It might, in fact, pay 5 per cent. upon its share capital, and with the balance of its profits form a reserve fund, which, in the course of twenty years, would amount to a sum sufficient to reconstruct the whole line of railway in the most substantial manner. The result would have been very different had its cost been equivalent to that of the principal English lines. The great error into which most of our engineers have fallen has been to rush at once into a profuse expenditure, constructing their works and stations on the most ample and expensive scale, instead of strictly limiting themselves, in the first instance, to the construction of such works as were clearly necessary for the traffic in the early stages of its development, and gradually extending them as the increasing traffic demanded enlarged accommodation. This latter course of procedure, in reference to railway operations, was strongly advocated so long ago as 1843, in a work entitled 'Ensamples of Railway Making.' If the views therein urged had been timely acted upon, the railway expenditure in this country would have been lessened by many millions; these magnificent undertakings (for they truly are so) would then have proved remunerative. It may now be laid down as a general axiom, that no railway which may in future be constructed will pay for the outlay if its cost approximate to the old standard of £30,000 and upwards per mile; and it may be considered as equally certain, that any line, the cost of which is limited to £10,000 or £12,000 a mile, will indubitably afford a good return to its shareholders, however thinly populated and unpromising may be the district through which it runs. It is important that these facts should be borne in mind in judging of the expediency of any prospective railway extensions. It is essential to our commercial prosperity and our pre-eminence as a nation, that none of the sources of wealth with which a beneficent Providence has so freely gifted this favoured country should remain undeveloped; not a mine nor quarry of importance, not a single agricultural district, should be allowed to remain without the advantages of railway communication. It is quite possible to effect this, and in such a manner as to insure an adequate return upon the capital employed; but it is to be effected only by the hearty co-operation of all parties interested in the matter, whether as landowners, occupiers or shareholders, and by the exercise of a rigid but sound economy in the formation of the works. Some few lines have lately been constructed under these conditions with the most signal success.

With reference to the old lines, those pioneers of our railway system by whose dearly-purchased experience we have been so slow to profit, there is hope for them yet. Although they can now never attain the high financial position they might have held as the best and safest of all investments, had their affairs always been conducted with prudence, sagacity, and integrity, still there is no reason to doubt that they will henceforth gradually, but steadily, improve. Inventive genius and mechanical skill, which are constantly economising the cost of production of all the staple articles of manufacture in this country, will yet accomplish much for railways. Improvements in the construction of permanent way and rolling stock; expedients for lessening the immense wear and tear, which are the result of carrying heavy loads at high velocities; improved means of generating and applying steam power; and, possibly, the substitution, ultimately, of some more economical, but equally powerful agent,—will all tend to lessen the heavy working charges which now press so severely upon railway resources. Further than this, we may reasonably expect that, by the aid of accumulated experience, railway working will virtually become a science; that greater immunity from accident will be obtained, consequent upon more perfect arrangement; and that by placing at the head of departments men of known ability and enlarged views—men who possess the art of conducting in the readiest manner and to the greatest advantage the vast amount of traffic which railways have developed, these important undertakings will eventually be raised from their present state of extreme depression."

A Treatise on the Stability of Retaining Walls. By John Murray, M. Inst. C. E.—John Weale, High Holborn.

We have received the first part of this work, and are much pleased therewith. The author has treated the subject in a practical and masterly style. Eschewing the complicated theories and the elaborated philosophisings of the French authors, he gives, instead, a careful selection of the best theories, and contrasts and compares them with practical examples from works executed, deducing practical rules of construction therefrom.

In the present part, the author treats—1st, Of the Centre of Gravity of Walls; 2ndly, Leverage of Walls; 3rdly, Pressure against Vertical Walls; 4thly, Slope of Earth, and the Weight of different Substances employed in building Walls; 5thly, Pressure of Earth against Vertical Walls; 6thly, Transformation of the Profiles of Walls; and, 7thly, The different Forms of Walls capable of resisting the pressure of earth.

The six sheets of diagrams given in illustration are well chosen, and carefully executed; and we hope shortly to see the next part, in which the author promises to treat of Counterforts and Casemated Revetments, and to give some of the best examples of walls *constructed* by English and foreign engineers.

When completed, this work will fill a void much felt by those whose professional employment upon such works of construction enables them to appreciate plain rules deduced from practical examples and experiments, when simply and distinctly set out, and fully illustrated; and it is for these reasons we recommend the first part of Mr. John Murray's excellent Treatise on the Stability of Retaining Walls, &c.

LIST OF NEW BOOKS, OR NEW EDITIONS OF BOOKS.

BRITISH ASSOCIATION REPORT.—Liverpool, 1854, 8vo, 18s. (Murray.)

HOPPUS'S Practical Measurer; or, Measuring Made Easy to the Meanest Capacity, by a new Set of Tables. With a Preface. 12mo (Manchester), pp. 212, bound, 2s. (Simpkin.)

SPENCER (H.)—Railway Morals and Railway Policy. By Herbert Spencer. 16mo, pp. 116, sewed, 1s. (Longman.)

STOCKHARDT'S Agricultural Chemistry; or, Chemical Field Lectures: a Familiar Exposition of the Chemistry of Agriculture, addressed to Farmers. Translated from the German, with Notes, by Professor Henfrey. To which is added a Paper on Liquid Manure, by J. J. Mechi. Post 8vo, pp. 379, cloth, 5s. (Bohn's Scientific Library.)

BERNAYS (A. J.)—First Lines in Chemistry: a Manual for Students. By Albert J. Bernays. Fcap., pp. 484, cloth, 7s. (Parker & Son.)

CHATTAWAY (E. D.)—Railways: their Capital and Dividends; with Statistics of their Working in Great Britain, &c. By E. D. Chattaway. 12mo, pp. 140, cloth, 1s. (Weale's Rudimentary Series.)

GALBRAITH (J. A.) and HAUGHTON (S.)—Manual of Astronomy. By the Rev. J. A. Galbraith and the Rev. Samuel Haughton. Fcap., pp. 169, cloth, 2s. 6d.; sewed, 2s. (Longman.)

JESSOP (W. H. R.)—A Complete Decimal System of Moneys and Measures. By W. H. R. Jessop. 12mo, pp. 48, sewed, 2s. (Bell.)

LARDNER (D.)—Handbook of Natural Philosophy—Mechanics. By Dionysius Lardner, D.C.L. 12mo, pp. 503, cloth, 5s. (Walton.)

SCOFFERN (J.)—Elementary Chemistry of the Imponderable Bodies; including Light, Heat, Electricity, &c. By John Scoffern. Crown 8vo, pp. 514, cloth, 4s. 6d. (Orr's Circle of the Sciences, Vol. IV.) (Houlston.)

WILLIAMS (W.)—Transparency Painting in Linen for Decorative Purposes, Panoramic and Dioramic Effects, Ornamental Blinds, &c.: with Instructions for the Preparation of the Linen, &c. By W. Williams. Illustrated by Charles Sibley; engraved by Dalziel. 12mo, pp. 60, sewed, 1s. (Winsor & Newton.)

*COLE (G.)—The Contractor's Book of Working, Drawings of Tools and Machines, used in constructing Canals, Railroads, and other Works; with Bills of Timber and Iron; also Tables and Data for calculating the Cost of Earth and other kinds of Works. Compiled by George Cole, Civil Engineer. Folio (New York), cloth, London, £3 3s.

* New American Book.

COMPARISON OF THE PERFORMANCE OF THE UNITED STATES STEAMERS MISSISSIPPI, SUSQUEHANNA, AND POWHATAN.†

By the kindness of one of the engineers attached to the Japan squadron in 1854, we are enabled to present an interesting comparison of the performance of the above-named steamers, abstracted from their steam-logs, during a cruise, side by side, from Loo Choo to Japan, February 7th to 13th, 1854, during the whole of which time they were within hailing distance, and of course influenced by the same winds, currents, &c. It is rarely that such opportunities occur, or that, when they do occur, such accounts are kept of the conditions of the engineering department as can be relied upon. Taken in connexion with the dimensions, &c. of the respective vessels previously furnished in this Journal, the abstract given below will not be devoid of interest or instruction.

Steamer Mississippi.

				Per Hour.			
Date.	Hours of steaming.	Steam pressure in pounds per square inch.	Revolutions per minute.	Pounds of Coal.	Speed, in feet of wheels.	Speed, in feet of ship.	Slip of wheel in per ct.
Feb. 7	12	10·85	8·74	2560	45,033	38,635	14·2
,, 8	24	9·20	8·60	2174	44,250	43,379	0·5
,, 9	24	6·33	9·67	1583	49,627	48,845	0·4
,, 10	24	8·43	8·93	2230	45,827	41,532	9·3
,, 11	24	11·90	8·61	3030	44,738	34,489	22·9
,, 12	11	12·18	7·76	2804	39,976	23,297	41·7

Steamer Powhatan.

Feb. 7	13	12·60	8·58	3231	46,630	35,820	23·0
,, 8	24	11·16	9·11	3411	49,558	43,379	12·5
,, 9	24	——	9·77	2523	53,096	48,845	8·0
,, 10	24	10·71	8·86	3183	48,694	41,532	14·7
,, 11	23	12·43	8·84	3990	48,310	35,980	25·5
,, 12	10	11·64	7·78	3359	41,392	23,297	43·7

Steamer Susquehanna.

Feb. 7	13	9·46	9·04	3241	47,600	35,820	24·7
,, 8	24	9·32	9·32	2970	49,462	43,379	12·3
,, 9	24	9·92	8·86	3475	51,614	48,845	5·3
,, 10	24	9·46	9·20	3010	50,818	41,532	18·3
,, 11	24	9·92	8·86	3975	47,054	34,489	26·7
,, 12	11	9·64	7·99	3682	42,426	23,297	45·1

Averages.

Mississippi . .	9·44	8·84	2336	45,330	39,982	11·79
Powhatan . .	11·60	8·96	3248	48,781	39,982	18·05
Susquehanna .	9·63	8·96	3310	48,840	39,648	18·82

From the above tables, it will be seen that the performance of the *Powhatan* and *Susquehanna* was nearly identical, but slightly in favour of the latter, and that in both the slip was over 50 per cent. more than in the *Mississippi.* The draft of water and dip of the wheels was not noted on any of the logs, which prevents our knowing the displacement of the vessels. It is, however, probable that all of them drew the average on sea service, and therefore that the comparison of their performance is a fair one. M.

---

† From the "Journal of the Franklin Institute."

AMERICAN NOTES.—No. XI.

European Steam Navigation.—The probability of the establishment of a new line of steamers from this country to Liverpool is daily improving. The merchants of Boston have entered into the enterprise with much spirit. The "Nautical Magazine" gives the following report:—

A meeting of parties interested in the prosecution of this enterprise took place on the 12th of July; and, after a brief and spirited discussiou, it was unanimously voted to be in consonance with the interests of Boston to establish a line between that eity and Europe, to consist of four ships. A Committee to solicit subscriptions to stock was appointed, and the meeting adjourned one month. At the end of this period, the persons named in the Massachusetts Act of Incorporation of the Boston and European Steam-ship Company met according to appointment, when the following proceedings were had:—

M. Beebe, Esq., was called to the chair; Hon. George Upton was chosen Secretary of the meeting.

The act of incorporation was accepted by vote.

F. W. Thayer, Esq., was chosen Clerk of the Company.

The gentlemen appointed as a Committee at the merchants' meeting, held on the 12th of July, were made members of the Company, viz.:—Messrs. R. B. Forbes, William Amory, George B. Upton, G. Howland Shaw, &c. &c.

The meeting also voted—That the Committee appointed at a meeting at the Merchants' Exchange be requested to proceed and make their collections to stock in the Company, and that the following form of subscription be adopted:—

"The undersigned agree to take the sums set against their names in the stock of the Boston and European Steam-ship Company, on the following terms and conditions, to wit:—

"1. That the sum to be subscribed shall be one and a half millions of dollars, and that no subscriptions shall be binding unless said amount shall be subscribed within twelve months of this date.

"2. On the completion of the amount above named, a Committee shall be appointed by the stockholders for the purpose of building not less than three ships, to cost about 500,000 dols. each.

"3. The shares shall be valued at 500 dols., and each shall be entitled to a vote."

The meeting then adjourned, to assemble again after the interval of a month.

The proposed steam-ships are estimated to cost 550,000 dols. each. A model, furnished by Donald M'Kay, Esq., was exhibited at the first meeting, on behalf of the Company, of the following dimensions and design:—Length, 320 feet; breadth, 45 feet; depth, 31 feet; engines, of 85-inch cylinder and 10 feet stroke, with plenty of boiler. The following estimate for a single voyage is based upon its capacity:—

			Dols.
Cost of sailing for the voyage, about			35,000
Interest and iusurance			8,000
Depreciation			3,000
Repairs			3,000
			49,000
	Dols.	Dols.	
220 first-class passengers	130	28,600	
50 second " "	75	3,750	
1,000 tons freight home	35	35,000	
Freight outward		2,000	
220 first-class passengers home		28,600	
50 second " " "		3,750	101,700
Profit for the voyage			52,700 dols.

It is expected that Donald M'Kay, Esq., of East Boston, the builder of the *Great Republic*, will construct the vessels of the Boston and European Steam-ship Company. It is the proud boast of the friends of this gentleman, that of the many celebrated ships which he has launched, not one of them has ever cost the Underwriters one dollar for losses at sea.

Collins' Line.—The hull of the new steamer of this line (the *Adriatic*) is progressing rapidly, the entire frame being raised. Her engines are to be oscillators, with cylinders of 100 inches in diameter, by 12 feet stroke of piston; four boilers, with vertical tubes, arranged very similar to those in the drawing sent you for No. cli. (August).

Vanderbilt's European Line.—The dimensions of the engines are now fixed, with cylinders of 90 inches diameter, and 12 feet stroke of piston.

The New York, Newfoundland, and London Submarine Telegraph.—The enterprise of the day is that of the "Telegraph Expedition," which has just been made by the New York, Newfoundland, and London Telegraph Company, to lay a submarine cable from the Island of Cape Breton to Newfoundland, under a contract, that the Transatlantic Company, composed of French and English capitalists, will, by January, 1858, connect with them at St. John's, Newfoundland.

The united Companies propose building a line from Halifax across the Island of Cape Breton to Cape North; thence across the Gulf of St. Lawrence to Cape Ray, on the south-western shore of Newfoundland; thence along the southern coast of the latter island to St. John's, on its eastern side; and there to connect with a great submarine cable, having its terminus at Cork, Ireland; the distance across the ocean between those points not being more than 1,680 miles. The land portion of the line is being rapidly built, while the submarine part of it, between Cape Breton and Newfoundland, the Company are sanguine will be completed next year. Along this proposed route from Cork to St. John's, the bottom of the sea is a plateau or ridge, as discovered by Lieut. Maury in 1853, which, from its apparent purpose of holding the wires of a submarine telegraph, has been called the Telegraph Plateau. It is about 70 fathoms deep, gradually increasing in depth from the shores of Newfoundland to near those of Ireland, and some two or three miles in width.

St. John's is about two days nearer England than Halifax, and contains equal facilities for coaling steamers. A dangerous rock, called the Merlin Rock, at the narrow entrance to the harbour, 18 feet below the surface of low water, has just been successfully removed by the orders and at the expense of this Company, under the supervision of Messrs. Husted and Kroehl, submarine engineers, of New York; so that now the largest steamers in the world can with safety pass in and out of that land-locked harbour. The laying of the cable has for the present failed, through the rough weather attending the expedition. Some miles of the cable were lost.

The process of making the cable is simple. Copper wire of a small size, of the requisite length, is taken and completely insulated by means of gutta-percha. Three copper wires, thus enveloped, are placed together, side by side, in as compact a space as possible, all the interstices between them being filled with rope-yarn. These three insulated wires are then twisted around each other by means of machinery, as in the strands of a rope, and the whole is completely surrounded by another envelope of gutta-percha. A transverse section of this cable gives the appearance of a solid gutta-percha rope, in which appear three copper wires, running through its whole length. This is enveloped by twelve distinct large iron wires, running parallel to it, which are strongly twisted around the gutta-percha rope, as before, by means of machinery, at an angle of 45 degrees: this is then smeared with tar, and is ready for use. Its diameter is an inch and a half.

To the untiring energy and indefatigable zeal of such men as Peter Cooper, Esq., and Cyrus W. Field, Esq., and to the skill and unwearied exertions of Samuel Canning, Esq., of London, we are indebted for this first attempt to link the European continent with the western world in an instant communication. No like company has ever had to contend against such natural obstacles, or to labour against greater difficulties; and though for the time being they have been unsuccessful, another season will probably witness the complete triumph of their perseverance and energy, in the successful establishment of their telegraph line from Halifax to St. John's.

Timber Rot.—Some years ago, a philosopher, being acquainted with the fact that every species of fungus, which is the real source of the rot in timber, can vegetate only ou substances which are soluble in water, made the following experiment with sawdust:—He took a portion of sawdust from a heap, and divided it into two equal parts. One heap was washed over and over again in water, till everything soluble was removed; the other heap was undisturbed.. Both having been dried, were placed, side by side, in a damp, close vault, and allowed to remain there several weeks. They were at length taken out, and the following was the result:—that portion which was washed until nothing more could be carried off by water, remained clean and bright as when it was carried into the vault; the unwashed portion had become the prey of foul parasites, and was completely imbedded in an offensive mass of mould. This experiment proved the theory of the philosopher, and convinced him that if by any means our timber of any sort could be deprived of all those matters contained in it which are soluble in water, it could be kept any number of years entirely free from rot.

Minie Rifle Ball.—Mr. William A. Sweet, also the inventor of a breech-loading rifle, has invented a machine by which balls for the Minié rifle are swedged from solid bars of lead. These balls, all our readers doubtless are aware, are of a peculiar form, differing from the common round ball in being of a conical shape with a cavity iu the base. Hitherto they have been invariably cast in moulds, in the same manner that the common bullet is cast; by which process it is impossible to make balls of equal weight, or free from imperfections. The bullet is discharged from the die, which again receives the bar, and repeats the process. The machine thus makes two bullets a second, or 120 a minute, and is capable of even faster work It requires but little attention, except to keep the hopper supplied with lead. It can be worked by steam-power or hand.

At the Government Arsenal there is a machine in operation by which the round ball is swedged out, and it is a great improvement over the old method of casting; but Mr. Sweet's invention differs entirely from that, and is far superior.

Business of the Patent Office.—Synopsis of the business of the United States Patent Office for fourteen years, ending December 31, 1854:—

	Caveats filed.	Applications received.	Patents granted.
Total	8,060	24,191	11,218

About 46 per cent. or nearly one-half of the applications made during these fourteen years have been attended with success. The percentage last year is greater than the average, being upwards of 58. This is attributed to the high qualifications of the present corps of the examiners in the Patent Office, and the late Commissioner, who proved himself to be a most competent officer.

New Steam Frigate "Niagara."—This vessel is rapidly approaching to completion; and as her performances are looked to with much interest, she being designed and constructed by Mr. George Steers, the builder of the yacht *America*, I give the following as her principal dimensions, viz.:—

Length on load-line	323 feet.
Length over all	345 "
Beam	55 "
Hull	31 "

She is strapped with diagonal and double-laid iron straps on the *outside* of her frame. She is to be full rigged as a ship, and to mount twelve 11-inch pivot-guns.

Goodfellow's Circular Die-Stock.—The annexed engraving represents Simeon Goodfellow's circular die-stock, for which a patent has been granted to him. Fig. 1 is a perspective view and Fig. 2 a bird's-eye view of the stock, with the guard-plate and the compound rectangular and plug die removed, showing the configuration of the convolute repeating scroll, used in lieu of a screw for compressing the dies. Fig. 3 is a geometrical view, showing the relative positions of all the dies as viewed on the surface-plate invented. Fig. 4 is a detached perspective view of the rectangular and plug die, with the small circular plug, H, partially withdrawn. Letters A on each figure indicate the die-stock; letter B, a moveable rim acting in the scroll; C, the guard-plate; D, the convolute repeating scroll; F F, graduated circular dies; G and H, rectangular and plug die.

Some of the advantages of this new die-stock and dies are, that a greater number of sizes of screw-bolts can be used in each stock or plate than is usual;

GOODFELLOW'S CIRCULAR DIE-STOCK.

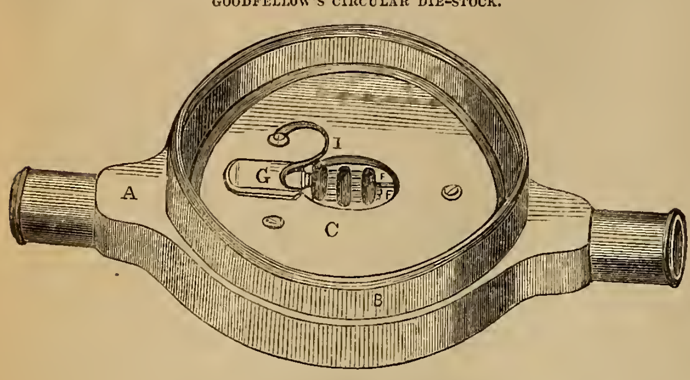


Fig. 1.

so that while the largest can be cut with ease, the smallest can be cut as well. A change from one size to another is readily effected, by turning in their sockets the two circular graduated dies F F, and the insertion of a small circular plug-die, H, to correspond, in the rectangular die G.

The threading-dies being circular, are self-adjusting, a peculiarity belonging only to such dies. This is thought by the patentee to be a great advantage

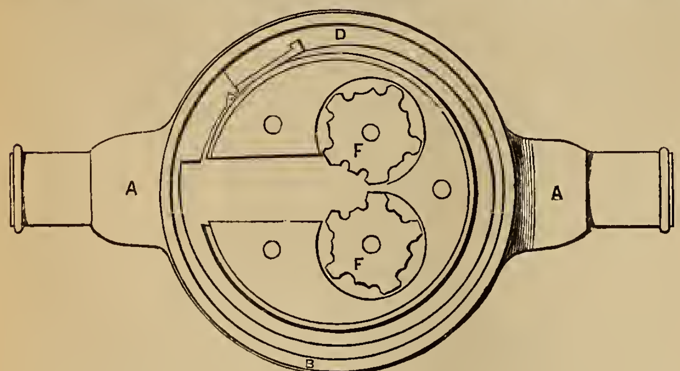


Fig. 2.

gained, as they are supposed to cut with good effect and with but little friction.

Other considerations in favour of this invention are, that they cut a cleaner thread and are less liable to break than any other; and it is thought, from actual experiment, that large screws can be cut with this instrument with as much ease as comparatively small ones can be in the usual way.

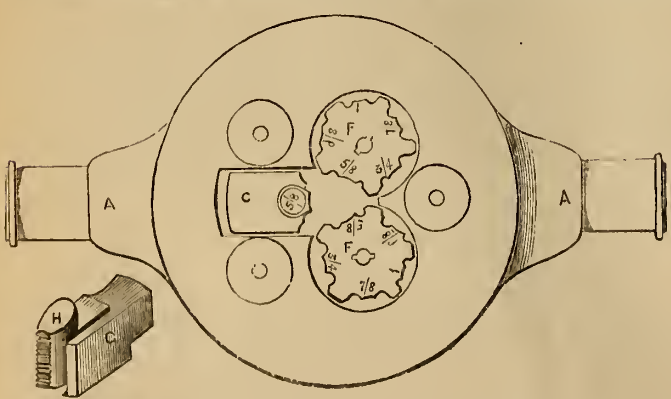


Fig. 4. Fig. 3.

The labour with this circular die-stock can well be performed by boys, the power of any young apprentice being sufficient. The convolute repeating scroll, producing an eccentric action, in lieu of the generally-used screw, to regulate the dies, is a valuable feature.

New York. H.

EXPERIMENTS ON THE PADDLE-WHEELS OF THE UNITED STATES FRIGATE MISSISSIPPI, TO DETERMINE THE INFLUENCE EXERTED ON THEIR SLIP BY THE OMISSION OF EVERY OTHER PADDLE.*

By B. F. Isherwood, Chief Engineer, United States Navy.

During the Mediterranean cruise of the United States steam-frigate *Mississippi*, in the years 1849, 1850, and 1851, an experiment was made by her chief engineer, Jesse E. Gray, U.S.N., to determine the influence on the slip of her paddle-wheels by the omission of every other paddle.

The *Mississippi* had occasion, in the course of this cruise, to make a number of short passages between Spezzia and Leghorn, along "the tideless shores of the Mediterranean," a distance of 37½ geographical miles of 6,085 feet. These passages were all made in fine weather, with light airs and smooth sea. The results were reasonably uniform; the vessel's draft of water and the immersion of the paddles not varying enough throughout to sensibly affect them. The mean of eight passages, made with the full number of twenty-one paddles in each wheel, the total number of revolutions made by the wheels being taken by a counter, gives accurate data for the slip with the paddle-wheels in their normal condition. After seven passages had been thus made, with considerable intervals of time between them, every other paddle was removed, reducing the number to eleven in each wheel in place of twenty-one, necessarily leaving two in their original juxtaposition from the odd (21) number of the original paddles. One passage was made with the paddles in this condition, with weather quite as fine and under circumstances quite as favourable as before; the total number of revolutions made by the wheels was ascertained by the counter as before. This last performance was not repeated from prudential motives, for the concussion and shock on the water of the entering paddles, now that they were removed so far apart, produced so excessive a vibration and shaking of every part of the vessel as to be very uncomfortable to the persons on board: the paddles struck the water as though it were a solid rather than a fluid substance. And this was the more remarkable, because with the twenty-one paddles in each wheel not the slightest vibration of the hull had ever been experienced from the action of the machinery, the *Mississippi* being noted for solidity and steadiness. The alternate paddles were now restored, and during the last passage between the same points, and under the same conditions of weather, &c. as before, the first results were again obtained; the vibration and shaking of the hull, and the violent concussions of the entering paddles on the water, entirely ceased with the restoration of the original paddle surface.

During these experiments the vessel's mean draft of water averaged 18 feet 11 inches. The paddle-wheels were 29 feet diameter from outside to outside of paddles—the paddles were 11 feet in length by 22 inches in width.

The following are the dates of the passages, together with the total number of revolutions made during each passage by the paddle-wheels. This number was taken by a counter receiving its motion from the engines. The time of making the passages, steam pressures, &c., though not observed with precision, were about the same throughout.

Date.	Passage.	Number of revolutions made by the paddle-wheels as taken by the counter.
	Steaming with 21 Paddles in each Wheel.	
Sept. 10, 1849	From Leghorn to Spezzia . .	3170
Nov. 17, ,,	,, Spezzia to Leghorn . .	2920
,, 25, ,,	,, Leghorn to Spezzia . .	2940
,, 27, ,,	,, Spezzia to Leghorn . .	3050
April 23, ,,	,, ,, ,, ,, . . .	2960
Oct. 14, 1850	,, ,, ,, ,, . . .	3050
,, 19, ,,	,, Leghorn to Spezzia . .	2980
May 31, 1851	,, ,, ,, ,, . . .	3020
	Mean of the eight passages . .	3011
	Steaming with 11 Paddles in each Wheel.	
April 19, 1851	From Leghorn to Spezzia . .	3536

With the above data, making the calculations for the slip of the centre of pressure of the paddles, we obtain the following results, viz.:—

Slip when steaming with 21 paddles in each wheel, 12·79 per centum.
,, ,, ,, 11 ,, ,, 25·74 ,, ,,

From the above it will be perceived that halving the number of paddles in each wheel by the omission of every other one, just doubled the slip. But few readers will probably have expected such a result, as the prevailing opinion is that such an omission of paddles would affect the slip to only an inconsiderable degree. But, beside the incontestable evidence of the self-registering counter, there is the strongly-marked effect produced upon the heavy and solid live-oak hull. With 21 paddles in each wheel, the paddles at their periphery were 4·338 feet from centre to centre; with 11 paddles in each wheel, they were 8·676 feet from centre to centre: this latter distance seems great enough to enable an intermediate paddle to act with full effect without enfeeblement from the adjacent ones. The entering paddle struck the water at an angle of 57° from the perpendicular, making the angle included between the paddle and water-level 33° only. Under these conditions, the mean loss of useful effect by the oblique action of the paddles on the water, calculated for every 10°, and as the squares of the series of their angles of incidence on the water, was 25·77 per centum of the power applied to them.

* From the "Journal of the Franklin Institute."

STORMS'S CLOUD-ENGINE.*

Mr. Wm. Mount Storms, of Philadelphia, U.S., a gentleman apparently well versed in all that relates to these interesting and extensive subjects, professes to have made new discoveries, or applications of natural laws, which are to result in increasing the efficiency of a given amount of fuel in the steam-engine. The Company formed to carry out and apply the intentions of Mr. Storms have subjected the theory to the test of several expensive experiments, and one engine of respectable size constructed on this plan has heen for some months in actual daily use, driving the fans and other machinery of a small foundry and machine shop. The plan consists in mixing cold air with ordinary steam. It is assumed that, in addition to the familiar forms of ice, water, and steam, the aqueous element is capable of existing in a state of vesicular vapour, or opaque steam—a form more familiar to the eye than the transparent steam, but never before suspected of possessing any mechanical power above or even equal to that of the latter.

If a glass bull's-eye be introduced in the top or side of an ordinary steam-boiler, the steam within is found to be perfectly transparent and invisible; but on turning a cock, the escaping steam is found to be white and cloud-like. This is due to the cooling effect of the air, which mixes with and apparently condenses it. Mr. Storm's experiments lead him to the conclusion that the volume of the whole is increased by the combination, and this to a very considerable degree, as high under favourable circumstances as 75 per cent., and consequently affording a corresponding increase of efficiency in an engine. If common air be compressed and introduced at an ordinary temperature into a vessel containing steam at the same pressure, the following effects may be anticipated:—On the one hand, a portion of the steam will be condensed and changed to water, which will diminish the pressure; but, on the other hand, the air will be heated and expanded: and these two effects may be supposed very nearly, if not exactly, to balance each other. But the experiments alluded to indicate a very decided increase of volume, provided there is a sufficient difference of temperature. If pure transparent steam be mingled with air previously heated to the same degree, none of this expansion is experienced, and it becomes a question how to compress air in a pump, and convey it in a cold state into a heated cylinder.

Mr. Storms avoids the solution of this difficult problem, by allowing the air to mix thoroughly with the steam at any temperature it may chance to have, cooling it afterwards by expansion. In other words, he mixes hot or warm air with the steam in the steam-chest, and does not expect the mixture to assume the cloud form until it commences to expand in the cylinder. The act of expanding cools both steam and air, hut in very different proportions. Pure steam of a high pressure (say 60 lbs.) has a temperature of about 310° F.; and if cut off at half-stroke, so as to double its volume by expansion, cools down to only about 270°, while air at the same temperature, if expanded to the same extent, cools down to about the freezing point. Thus, the combined fluids may readily be compelled by expansion to assume the form of cloud or vesicular vapour, if the presence of air at a different temperature be the only condition necessary. To accomplish this object in an ordinary horizontal engine, Mr. Storms has, in the instance above referred to, placed a double-acting air-pump near the cylinder, and allows it to discharge into the steam-chest just above the valve. As the first portion of the stroke of the pump is spent in simply compressing its contents, it is so timed that it will begin to deliver with the commencement of the stroke of the piston. The pump is enveloped in a jacket of cold water to keep it cool, and the air probably enters the steam-chest at a temperature of from 180° to 250°.

A series of experiments have been lately tried at the Novelty Works on a tolerably large scale. The engine was run first with steam alone, and then with the cloud combination, the resistance being constant in all cases. The revolutions produced per lb. of coal were as follows: Steam 107, cloud 190; showing a great advantage by the use of the cloud vapour.

ON THE COMMERCIAL ECONOMY OF WORKING STEAM EXPANSIVELY IN MARINE ENGINES, WITH DESCRIPTION OF A NEW DOUBLE EXPANSIVE MARINE ENGINE.†

By Mr. Edward E. Allen, of London.

(Continued from page 243.)

Table VIII. gives an approximation to the yearly cost of coal used by five classes of vessels, with the relation it bears to their cost.

Table VIII.

Table of the Quantity and Cost of Coal used, per annum, in different Classes of Vessels; and Relation of Cost of Coal to Cost of Vessel, and also to Cost of Machinery.

Class.	Service.	Ratio of Time under weigh.	Number of Voyages per Annum.	Consumption of Coal per Voyage.	Total Consumption per Annum.	Cost of Coal per Ton.	Total Yearly Cost of Coal.	Assumed Cost of Vessel complete.	Assumed Cost of Machinery alone.	Ratio of Cost of Machinery to Cost of Vessel.	Cost of Engines alone (assumed at half the Machinery) in Per-centage of Cost of Vessel.	Cost of Coals in Per-centage of Cost of Vessel.
				Tons per Voyage.	Tons.	s. d.	£	£	£	PerCent.	Per Cent.	PerCent.
1	River	$\frac{1}{3}$	—	6	1,800	16 0	1,400	8,000	4,800	60	30	$17\frac{1}{2}$
2	Continental	$\frac{1}{3}$	40	30	1,200	16 0	1,000	18,000	7,200	40	20	$5\frac{1}{2}$
3	American	$\frac{1}{3}$	6	1,500	9,000	12 0	5,400	90,000	27,000	30	15	6
4	Australian	$\frac{2}{3}$	2	2,500	5,000	60 0	15,000	60,000	18,000	30	15	25
5	Eastern Steam Navigation Company	$\frac{1}{2}$	3	12,000	36,000	12 0	25,000	500,000	150,000	30	15	5

Note.—The Royal Mail Steam Packet Company's Accounts for 1850 give the Cost of Coal at 15 per cent. of the Cost of Vessel, and the Cost of Machinery at about 40 per cent. of the Cost of Vessel, or *Engines alone* at 20 per cent.

These comparisons will be found useful when the advantages of increasing the size of the engines are considered.

The cost of coal in London is taken at 16s. per ton.
The cost of coal in Liverpool is taken at 12s. per ton.
The cost of coal for Australian vessels, at an average of 60s. per ton.
The cost of coal for Eastern Steam Navigation Company, at 12s. per ton.

The price of coal is sometimes above these amounts, but they are near enough to illustrate the argument intended.

For better comparison, it will be desirable to condense the results; and this Table gives us the cost of engines alone (assumed at half the total cost of machinery) in

Classes 3, 4, and 5 ...... at 15 per cent. of the capital;
Class 2 .... at 20 per cent. of the capital;
Class 1 .... at 30 per cent. of the capital.

Also the yearly cost of coal in

Classes 2, 3, and 5 ...... at, say 5 per cent. of the capital;
Class 1 .... at, say 15 per cent. of the capital;
Class 4 .... at, say 25 per cent. of the capital.

In further illustration of this part of the subject, the subjoined accounts are added.

The following account, in Table IX., is given by the West India Mail Steam-Packet Company, showing the relative cost of coal, wages, &c., for 1850 and 1852; the amounts being the mileage expenses:—

Table IX.

West India Mail Company, Mileage Expenses.

	1850.		1852.	
	Per Mile run.	Per-centages of Total.	Per Mile run.	Per-centages of Total.
	s. d.		s. d.	
Coals	3 10	30·07	5 4	35·55
Wages	2 1	16·34	1 10	12·22
Victualling	1 5	11·11	1 5	9·45
Stores	0 8	5·23	0 8	4·45
General service	1 3	9·80	1 5	9·45
Port charges	0 3	1·96	0 4	2·22
Insurance	1 3	9·80	1 7	10·55
Repairs	2 0	15·69	2 5	16·11
Total	12 9	100·00	15 0	100·00

This gives the cost of coals in 1850 equal to 30 per cent. of the total working cost; and in 1852, equal to $35\frac{1}{2}$ per cent.

* From the "Journal of the Franklin Institute."

† Paper read before the Institution of Mechanical Engineers.

Table X. gives the total actual expenses of coals, wages, &c., of the same Company for the year 1850, and the per-centages of these items on the total cost of vessels.

TABLE X.

West India Mail Steam Packet Company.

	Working Expenses in 1850.	Per-centage of Total.		Per-centage on Cost of Vessels.
	£ s. d.			
Coals, freight, and all charges	88,436 0 7	28·17	Total Cost of Vessels, £692,249 1s. 10d.	12¾
Wages	44,853 13 10	14·29		6¾
Provisions	63,863 9 7	20·34		9¼
Stores	15,387 8 0	4·90		2¼
Port charges and pilotage	6,745 0 1	2·15		1
General service and stations	13,179 10 5	4·20		2
Coal-sacks	1,927 9 2	·62		¼
Office and law	1,713 1 8	·55		¼
Salaries	11,730 17 2	3·74		1¾
Insurance	25,000 0 0	7·96		3½
Repairs, ship, and machinery	41,055 8 10	13·08		6
Total	313,896 19 4	100·00		45½ per cent.

This Table gives the cost of coals in 1850 equal to 28 per cent. of the working expenses, and nearly 13 per cent. of the total cost of vessels, and the whole working expenses at 45½ per cent. of the cost of vessels.

If the mileage working expenses for 1850 be taken to amount to 45½ per cent. of the capital, then in 1852 the same expenses would be 53½ per cent.; and from the respective ratios of the cost of coals to the total working expenses for those years we have 13·74 per cent., and 19·02 per cent. as the cost of coals on the capital: consequently, 15 per cent. may be fairly taken as a mean.

For easy reference, the following Table, XI., is given :—

TABLE XI.

When the Annual Cost of Coal on Capital amounts respectively to	5 per cent.	15 per cent.	25 per cent.
Then 10 per cent. saving in coal equals	½ per cent. on capital.	1½ per cent. on capital.	2½ per cent. on capital.
,, 20 ,, ,, ,, ,,	1 ,,	3 ,,	5 ,,
,, 30 ,, ,, ,, ,,	1½ ,,	4½ ,,	7½ ,,
,, 40 ,, ,, ,, ,,	2 ,,	6 ,,	10 ,,

As the least of these savings, in the middle column, frequently makes all the difference between a good and bad paying concern, it is quite certain that upon the expenses of the single item of coal may frequently hang the very existence of a Company.

It will be seen from the foregoing accounts, that there is little room for economising the expenditure upon any other item to anything like the extent possible in the item of coals alone, as the largest amount next that for coals, according to the mileage expenses, is for wages or repairs, each of these amounting to only about half the cost of the coals.

The following Tables, XII., XIII., XIV., have been compiled in order to show the increased dividend on original capital which may be made by a saving in coal owing to expansive working of the steam, the size or nominal horse-power of the engines being supposed to be increased from 1 to 1½, 2, 2½, and 3 times respectively, the extra cost of larger engines being proportionately allowed for, and the boilers and wheels or screw supposed to remain the same. The indicated or real horse-power is also supposed to remain the same, the larger engines being solely for the purpose of working the steam expansively.

TABLE XII.

Table showing the Increased Dividend on Capital by a Saving in Coal from Expansive Working; the extra Cost of larger Engines being taken into account; Boilers, Wheels or Screw, and Indicated Horse-power, being supposed to remain the same.

		ANNUAL COST OF COALS TAKEN AT 5 PER CENT. OF CAPITAL.							
				Cost of Engines alone (exclusive of Boilers, Screw, &c.) equal to 15 per cent. of Capital (say as in Classes 3 and 5).			Cost of Engines alone (exclusive of Boilers, Screw, &c.) equal to 20 per cent. of Capital (say as in Class 2).		
Proportional Nominal Horse-power or Size of Engines.	Proportional Cost of Coal for same Actual Power.	Cost of Coal in Per-centage of original Capital.	Saving in Cost of Coal in Per-centage of original Capital.	Increasing the Nominal Horse-power adds to Capital invested.	Permanent Charge on Capital, being 5 per cent. on Addition.	Gross Gain on Capital, deducting Amounts in F from D.	Increasing the Nominal Horse-power adds to Capital invested.	Permanent Charge on Capital, being 5 per cent. on Addition.	Gross Gain on Capital, deducting Amounts in I from D.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	1·00	5·00	..	..	..	..	..	..	..
1½	·81	4·05	·95	7·50	·37	·57	10·00	·50	·45
2	·71	3·55	1·45	15·00	·75	·70	20·00	1·00	·45
2½	·63	3·15	1·85	22·50	1·12	·72	30·00	1·50	·35
3	·57	2·85	2·15	30·00	1·50	·65	40·00	2·00	·15
A	B	C	D	E	F	G	H	I	J

TABLE XIII.

Table showing the Increased Dividend by a Saving in Coal from Expansive Working; the extra Cost of larger Engines being taken into account; Boilers, Wheels or Screw, and Indicated Horse-power, being supposed to remain the same.

		ANNUAL COST OF COALS TAKEN AT 15 PER CENT. OF CAPITAL.							
				Cost of Engines alone (exclusive of Boilers, Screw, &c.) equals 20 per cent. of Capital (as in West India Mail Boats).			Cost of Engines alone (exclusive of Boilers, Screw, &c.) equals 30 per cent. of Capital (as in River Boats, Class 1).		
Proportional Nominal Horse-power or Size of Engines.	Proportional Cost of Coal for same Actual Power.	Cost of Coal in Per-centage of original Capital.	Saving in Cost of Coal in Per-centage of original Capital.	Increasing the Nominal Horse-power, adds to Capital invested.	Permanent Charge on Capital, being 5 per cent. on Addition.	Gross Gain on Capital, deducting Amounts in F from D.	Increasing the Nominal Horse-power, adds to Capital invested.	Permanent Charge on Capital, being 5 per cent. on Addition.	Gross Gain on Capital, deducting Amounts in I from D.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	1·00	15·00	—	—	—	—	—	—	—
1½	·81	12·15	2·85	·10	·50	2·35	·15	·75	2·10
2	·71	10·65	4·35	·20	1·00	3·35	·30	1·50	2·85
2½	·63	9·45	5·55	·30	1·50	4·05	·45	2·25	3·30
3	·57	8·55	6·45	·40	2·00	4·45	·60	3·00	3·45
A	B	C	D	E	F	G	H	I	J

The first Table, XII., is based on the supposition that the annual cost of coals is equal to 5 per cent. on the capital, and nearly agrees with the classes of vessels numbered 2, 3, and 5, in the former Table, VIII.

This proportionate cost of coals is here applied to cases in which the cost of the engine-power (exclusive of boilers, wheels, or screw) is equal to 15 per cent. of the capital, say as in Classes 3 and 5, and also to cases in which the cost of the engine-power is 20 per cent. of the capital, as in Class 2. Column A gives the proportionate size or nominal horse-power of engines; column B, the proportionate quantity of coal required to develop an equal amount of power (in each case); column C, the proportionate cost of coal in per-centage of capital; column D, the proportionate saving in cost of coal in per-centage of capital: from which it appears that if the size of the engines be doubled, the saving is 1·45 per cent. on the capital; and if the size of the engines be increased to 3 times, the saving is 2·15 per cent. on the capital. From this saving on the item of coal, however, must be deducted the interest on the extra cost of larger engines; and this deduction will vary according to the proportionate expenses of the engines to the capital. Columns E, F, G, apply to the case in which the cost of the engines alone (exclusive of boilers, wheels, or screw) amounts to 15 per cent. of capital (as in American vessels, and the Eastern Steam Navigation Company); and columns H, I, J, to the case in which the cost of engines alone amounts to 20 per cent of capital, as in Continental steamers, &c. Columns E and H give the necessary per-centage of increase of capital; columns F and I, the permanent charge on capital, being 5 per cent. allowed on the necessary addition made to it; and columns G and J, the gross gain in per-centage of capital, after deducting the interest on extra cost of engines from the total gain or saving in coal. These results show that if the size of the engines be doubled, an additional 0·70 or 0·45 per cent. may be paid on capital; and that upon the engines being increased to three times the size, an additional 0·65 or 0·15 per cent. may be paid on capital, according as the cost of the engine-power amounts to 15 per cent. or 20 per cent. of the capital respectively.

The second Table, XIII., is constructed in the same manner as the first, the annual cost of coals being taken at 15 per cent. of the capital, which, as before mentioned, applies to the class of vessels marked 1, and the West India Mail boats. This annual cost of coals is applied to the cases in which the cost of engines (exclusive of boilers, wheels, or screw) amounts to 20 per cent. of the capital, and also to the cases in which the cost of engines alone amounts to 30 per cent. of the capital. The general results are, that if the engines be increased to double the size for the sake of expansive working, the saving of coal would be 4·35 per cent. of capital; and if the engines be increased to three times the size, the saving in coal would be 6·45 per cent. of capital. These amounts are reduced by the extra cost of engines respectively to 3·35 per cent. and 2·85 per cent. of capital, and to 4·45 per cent. and 3·45 per cent. of capital, according as the cost of engine-power amounts to 20 per cent. or 30 per cent. of capital.

Table XIV.

Table showing the Increased Dividend by a Saving in Coal from Expansive Working; the extra Cost of larger Engines being taken into account; Boilers, Wheels or Screw, and Indicated Horse-power, being supposed to remain the same.

Proportional Nominal Horse-power or Size of Engines.	Proportional Cost of Coal for same Actual Power.	Annual cost of coals taken at 25 per cent. of capital.				
		Cost of Coal in Per-centage of original Capital.	Saving in Cost of Coal in Per-centage of original Capital.	Cost of Engines alone (exclusive of Boilers, Screw, &c.) equal to 15 per cent. of Capital (as in Australian Vessels, Class 4).		
				Increasing the Nominal Horse-power adds to Capital invested.	Permanent Charge on Capital, being 5 per cent. on Addition.	Gross Gain on Capital, deducting the Amounts in F from D.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	1·00	25·00	—	—	—	—
$1\frac{1}{2}$	·81	20·25	4·75	7·50	·37	4·38
2	·71	17·75	7·25	15·00	·75	6·50
$2\frac{1}{2}$	·63	15·75	9·25	22·50	1·12	8·13
3	·57	14·25	10·75	30·00	1·50	9·25
A	B	C	D	E	F	G

The third Table, XIV., is constructed in the same manner as the two former ones, the annual cost of coals being taken at 25 per cent. of the capital, which, as shown before, applies to the Australian vessels, or Class 4, where the cost of engines alone (exclusive of boilers, wheels, or screw) is equal to about 15 per cent. of capital. The results are, that if the size of the engines be doubled for expansive working, the saving of coal would amount to 7·25 per cent. of capital; and if increased to 3 times the size, the saving of coal would amount to 10·75 per cent. of capital. These amounts are reduced by the extra cost of engines to 6·50 per cent. and 9·25 per cent. of capital.

It is evident that the dearer the coal is, or the larger the quantity consumed in proportion to the actual power developed, the more advantageous would be the saving effected by expansive working, as the per-centage of saving in coal would the sooner cover any extra cost of engines; and the foregoing Tables clearly show that if the size of the engines be increased to *three* times for expansive working, and their *cost* be consequently *doubled*, there yet remains a gain, under the worst circumstances, of ·15 per cent. on capital, and under favourable circumstances, such as those presented by the Australian vessels, of $9\frac{1}{4}$ per cent. on capital.*

It is proposed now to consider the effect of increasing the size of the engines for expansive working, as regards the *total weights* carried; and the following Table, XV., gives the relative increase of weight resulting from an ordinary engine being increased in size from 1 to $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3 times; also the proportionate quantity of coal consumed in a given time; the saving in weight of coal balancing the increase in weight of engines, where the proportion of coal is large. The two last columns give the ratios of time, and the proportionate number of days the coal would last in the respective cases, if the gross weights carried were kept the same.

The general results may be given as follows:—that when the size of the engines is doubled, the gross weights of machinery and coal together are—

			Increase.
Increased in Class 1,	from 1·25 to 1·68,	equal to	34 per cent.
„ in Class 2,	from 2·00 to 2·21,	equal to	$10\frac{1}{2}$ „
„ in Class 3,	from 2·50 to 2·56,	equal to	$2\frac{1}{2}$ „

and are

			Decrease.
Decreased in Class 4,	from 5·00 to 4·34,	equal to	13 per cent.
„ in Class 5,	from 8·00 to 6·47,	equal to	19 „

Also when the size of the engines is increased to 3 times, the gross weights of machinery and coal together are

			Increase.
Increased in Class 1,	from 1·25 to 2·14,	equal to	71 per cent.
„ in Class 2,	from 2·00 to 2·57,	equal to	$28\frac{1}{2}$ „
„ in Class 3,	from 2·50 to 2·85,	equal to	14 „

and are

			Decrease.
Decreased in Class 4,	from 5·00 to 4·28,	equal to	14 per cent.
„ in Class 5,	from 8·00 to 5·99,	equal to	25 „

Table XV.

Table showing the Proportionate Weights of Machinery and Coal, and Joint Weights of same, when the Size or Nominal Horse-power of Engines is varied; Indicated Horse-power supposed the same in all cases respectively.

Class.	Service.	Ratios of Nominal Horse-power.	† Ratios of Weight of Machinery corresponding to increase of Nominal Horse-power.	Ratios of Weight of Coal corresponding to increase of Nominal Horse-power.	Ratios of Total Weights.	Ratios of Time the Coal would last if the total weights be kept the same.	Ratio in Days.
1	River.	1	1·00	·25	1·25	1	$2\frac{1}{2}$
		$1\frac{1}{2}$	1·25	·20	1·45	—	—
		2	1·50	·18	1·68	—	—
		$2\frac{1}{2}$	1·75	·16	1·91	—	—
		3	2·00	·14	2·14	—	—
2	Coasting and Continental.	1	1·00	1·00	2·00	1·00	10
		$1\frac{1}{2}$	1·25	·81	2·06	·92	9
		2	1·50	·71	2·21	·70	7
		$2\frac{1}{2}$	1·75	·63	2·38	·39	4
		3	2·00	·57	2·57	·00	0
3	Ocean (short voyages) and Government.	1	1·00	1·50	2·50	1·00	15
		$1\frac{1}{2}$	1·25	1·21	2·46	1·03	$15\frac{1}{2}$
		2	1·50	1·06	2·56	·94	14
		$2\frac{1}{2}$	1·75	·94	2·69	·80	12
		3	2·00	·85	2·85	·59	9
4	Ocean (long voyages), Australian.	1	1·00	4·00	5·00	1·00	40
		$1\frac{1}{2}$	1·25	3·24	4·49	1·15	46
		2	1·50	2·84	4·34	1·23	49
		$2\frac{1}{2}$	1·75	2·52	4·27	1·29	$51\frac{1}{2}$
		3	2·00	2·28	4·28	1·31	$52\frac{1}{2}$
5	Ocean (voyages out and home), Eastern Steam Navigation Company.	1	1·00	7·00	8·00	1·00	70
		$1\frac{1}{2}$	1·25	5·67	6·92	1·19	83
		2	1·50	4·97	6·47	1·30	91
		$2\frac{1}{2}$	1·75	4·41	6·16	1·41	99
		3	2·00	3·99	5·99	1·50	105

* It has not been considered necessary to include more than the five classes of vessels in the foregoing Tables, although many other classes exist in which the proportionate cost of coal and machinery varies from the amounts given. In order, however, to ascertain what advantages would be gained by the substitution of larger engines in any specific case, it will only be necessary to substitute the correct amounts in place of those given above.

† The boilers, water, wheels or screw, are supposed the same, and the engines alone equal to half the gross weight of machinery.

The last columns show that in the 4th Class, where the weight of coal carried is equal to 4 times the gross weight of machinery, if the size of the engines be doubled, the same gross weight being taken, then the coals will last 9 days longer—equal to 22 per cent. increase; and if the size of the engines be increased to 3 times, and the gross weight carried be kept the same, then the coal will last 12½ days longer—equal to 31 per cent. increase.

Also in the 5th Class, where the weight of coal carried is equal to 7 times the gross weight of machinery, if the size of the engines be doubled, the gross weight being kept the same, then the coal will last 21 days longer—equal to 30 per cent. increase; and if the size of the engines be increased to 3 times, and the gross weight carried be kept the same, then the coal will last 35 days longer—equal to 50 per cent. increase.

The last part of the subject to be now considered, is the effect which the increase in the size of the engines has upon the *total spaces* occupied by machinery and coals together. Table XVI. gives the results, where the size increases from 1 to 1½, 2, 2½, and 3 times, for the three divisions into which the five classes of vessels, before spoken of, are reduced.

In Class 1 the coals occupy a space *equal* to that occupied by the engines alone; in Classes 2 and 3, *three times*, and in Classes 4 and 5, *five times* the space occupied by the engines alone.

The space above spoken of is horizontal space, taken at the greatest beam of the vessels.

The general results are, that if the size of the engines be doubled, then the total space occupied by machinery and coals taken together (the coals lasting the same time in all cases)—

In Class 1, .. increases from 4·00 to 4·21, equal to 5 per cent.
In Classes 2 and 3, decreases from 6·00 to 5·63, equal to 6 ,,
In Classes 4 and 5, decreases from 8·00 to 7·05, equal to 12 ,,

Also, if the size of the engines be increased 3 times, then the total space occupied by machinery and coals taken together—

In Class 1, .. increases from 4·00 to 4·57, equal to 14 per cent.
In Classes 2 and 3, decreases from 6·00 to 5·71, equal to 5 ,,
In Classes 4 and 5, decreases from 8·00 to 6·85, equal to 15 ,,

Table XVI.

Table showing the Relative Spaces occupied by Engines, Boilers, and Passages, and Coals, separately and together; the Size or Nominal Horse-power increasing from 1 to 3; the Actual or Indicated Horse-power remaining the same.

Class.	Service.	Ratios of Size or Nominal Horse-power.	Ratios of Spaces occupied by Engines alone. *	Spaces occupied by Boilers and Passages (constant). **	Ratios of Spaces occupied by Coals. ***	Ratios of Total Spaces.
1	River.	1	1·00	2	1·00	4·00
		1½	1·25	2	·81	4·06
		2	1·50	2	·71	4·21
		2½	1·75	2	·63	4·38
		3	2·00	2	·57	4·57
2 and 3	Coasting and Continental, and Ocean (short voyages).	1	1·00	2	3·00	6·00
		1½	1·25	2	2·43	5·68
		2	1·50	2	2·13	5·63
		2½	1·75	2	1·89	5·64
		3	2·00	2	1·71	5·71
4 and 5	Ocean (long voyages), and Eastern Steam Navigation Company's vessels.	1	1·00	2	5·00	8·00
		1½	1·25	2	4·05	7·30
		2	1·50	2	3·55	7·05
		2½	1·75	2	3·15	6·90
		3	2·00	2	2·85	6·85

Table XVII. shows how the *cargo-space* is diminished or increased under the three suppositions, that the machinery and coal space is *equal* to the cargo-space, or to *two-thirds* or to *one-half* the cargo-space; these proportions embracing the ordinary limits.

---

* The actual horizontal space occupied by engines may be taken generally at ¾ square foot per nominal horse-power.

** The actual space occupied by boilers may be taken at 1 square foot per nominal horse-power, and passages at ½ square foot.

*** The space occupied by the coals varies;—Class 1, ¾ square foot; Classes 2 and 3, 2¼ square feet; and Classes 4 and 5, 3¾ square feet, per nominal horse-power.

Ratios—Engines, 1; boilers and passages, 2; coals, 1, 3, and 5, respectively.

Table XVII.

Table showing the Per-centage of Loss or Gain in Cargo Space, and the Per-centage of Saving in quantity of Coals required, when the Size or nominal Horse-power of the Engines is increased, the Indicated Horse-power being the same.

Ratios of Total Spaces occupied by Machinery and Coals (from foregoing Table).	The same Ratios, but showing the Per-centage of Increase or Decrease.	Per-centage in which the Cargo Space is diminished or increased. 1st. When the total Machinery and Coal Space is *equal* to the total Cargo Space.	2nd. When the total Machinery and Coal Space is *two-thirds* of the total Cargo Space.	3rd. When the total Machinery and Coal Space is *one-half* of the total Cargo Space.	Ratios of Coals consumed in the same time, and developing the same power.	Per-centage of Coal saved by Expansive Working.
4·00	100	diminishes per cent.	diminishes per cent.	diminishes per cent.	100	per cent. —
4·06	101½	1½	1	¾	81	19
4·21	105	5	3⅓	2½	71	29
4·38	109	9	6	4½	63	37
4·57	114	14	9⅓	7	57	43
6·00	100	increases per cent.	increases per cent.	increases per cent.	100	per cent. —
5·68	94	6	4	3	81	19
5·63	94	6	4	3	71	29
5·64	94	6	4	3	63	37
5·71	95	5	3⅓	2½	57	43
8·00	100	increases per cent.	increases per cent.	increases per cent.	100	per cent. —
7·30	91	9	6	4½	81	19
7·05	88	12	8	6	71	29
6·90	86	14	9⅓	7	63	37
6·85	85	15	10	7½	57	43

If the engines be doubled in size, then
In Class 1, ... the cargo-space diminishes 5, 3⅓, and 2½ per cent.
In Classes 2 and 3, ,, ,, increases 6, 4, and 3 ,,
In Classes 4 and 5, ,, ,, increases 12, 8, and 6 ,,
If the engines be increased in size 3 times, then
In Class 1, the cargo-space diminishes 14, 9⅓, and 7 per cent.
In Classes 2 and 3, ,, ,, increases 5, 3⅓, and 2½ ,,
In Classes 4 and 5, ,, ,, increases 15, 10, and 7½ ,,
The last column gives the per-centage of saving in coal.

The effects of *increasing the size* or nominal horse-power of engines, for the purpose of working the steam more expansively, have now been considered, in respect both to the *increased first cost of machinery*, so far at least as the interest on the increased capital is concerned, the *saving of coal* in per-centage of capital, the *increase of weight of machinery*, and the *saving in weight of coal*, and also in respect to the *total spaces occupied by machinery and coal*, as also the effect of the changes on the *cargo-space* in per-centage of the first supposed cargo-space; and it is considered that the results are such as are not generally known, and that merchants and shipowners are wholly unaware of the advantages of working steam expansively, even should they be compelled at the outset to pay double the amount now usually paid for engine-power.

It would appear certain that if no alternative existed but that of increasing, say the diameter of the cylinders of marine engines, and thus increasing the first cost in about the proportion of 1½ times for double the size, and 2 times for 3 times the size (the boilers, wheels, or screw being supposed to remain the same), ample reason still exists for making such a change in contracting for engines intended for vessels carrying a large proportion of coal; and it has been shown that if double the ordinary amount be paid for the machinery, yet 9¼ per cent. increase may be paid upon the capital in some cases, after deducting for the extra cost of engines, by the economy in coal alone.

It has also been shown that notwithstanding the increased size of engines (supposed to be increased 3 times), the Australian vessels carrying a large proportion of coal present opportunities of gaining 15 per cent. in many cases in cargo-room; and further, that about 14 per cent. may be saved in the gross weights carried, taking machinery and coals together; or that so much more additional coal could be taken for a longer voyage without re-coaling.

In the foregoing Tables, the size or nominal horse-power of engines has been supposed to be increased 3 times, as a limit; but no advantage has been named as resulting from the diminished cost of the boilers, since, less steam being required to develop the same power, smaller boilers would suffice. Considerable advantage, however, would follow from this reduction; or advantages might be shown, in decrease of weight and space in the boilers; but it has been considered best not to encumber the calculations with so many considerations.

The gain in cargo-space is altogether an additional saving to that already named as resulting from economy in quantity of coal; but this source of profit has only been shown in a per-centage of increase of cargo-space, and no money-value can be set upon it, as it varies so much with the nature of the trade and freight obtained.

The following Table, XVIII., presents a general summary of what has been before stated; and it will be seen from this table, that until the quantity of coals taken in proportion to weight of machinery at least equals $1\frac{1}{2}$ times, as in Class 3, or rather until it equals 2 times the gross weight of machinery, no change could be advantageously made by increasing the nominal horse-power or size of the engines, inasmuch as (on the conditions assumed) the weight of the machinery increases more rapidly than the weight of the coal diminishes.

In Classes 4 and 5, however, an *increase in the weight of the engines* is soon covered by the *reduction in weight of coal* required.

The increase in the weight of engines would be found to be about balanced by the decrease in weight of coal required, if the quantity of coal taken was equal to double the gross weight of machinery; the boilers being supposed to remain the same. In these calculations, it must be remembered that the boilers are supposed to remain the same, and the weight of the engines alone are supposed to increase in the ratio of $1\frac{1}{2}$ times the weight for double the size or nominal horse-power, and 2 times the weight for 3 times the size or nominal horse-power.

TABLE XVIII.—GENERAL SUMMARY.

Table compiled from the foregoing Tables, the Size or Nominal Horse-power increasing from 1 *to* 2 *and* 3 *times* (*the intermediate sizes being omitted*), *and based on the supposition that in order to work expansively, the Engines must be increased in cost, weight, and size, the Boilers being assumed to remain the same. The steam-pressure supposed at only about* 20 *lbs. above the atmosphere.*

Class.	Service.	Ratio of Size or Nominal Horse-power.	Saving in Coal in Per-centage of Capital.	Increase of Capital per Cent.	Total Weights of Coal and Machinery, Increase or Decrease per Cent.	Total Spaces occupied by Coal and Machinery, Increase or Decrease per Cent.	Cargo Space, Decrease or Increase per Cent. When total Machinery and Coal Space is *equal* to Cargo Space.	When total Machinery and Coal Space is $\frac{2}{3}$ of Cargo Space.	When total Machinery and Coal Space is $\frac{1}{2}$ of Cargo Space.	Per-centage of Increase of Time the Coals would last, if the total Weights be kept the same.	No. of Days the Coals will last, if total Weights be kept the same.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Days.
		1	—	—	Increases	Increases	Decreases	Decreases	Decreases	—	$2\frac{1}{2}$
1	River	2	4·35	30	34	5	5	$3\frac{1}{3}$	$2\frac{1}{2}$	—	—
		3	6·45	60	71	14	14	$9\frac{1}{3}$	7	—	—
		1	—	—	Increases	Decreases	Increases	Increases	Increases	—	10
2	Continental	2	1·45	20	$10\frac{1}{2}$	6	6	4	3	—	—
		3	2·15	40	$28\frac{1}{2}$	5	5	$3\frac{1}{3}$	$2\frac{1}{2}$	—	—
		1	—	—	Increases	Decreases	Increases	Increases	Increases	—	15
3	Ocean, short voyage	2	1·45	15	$2\frac{1}{2}$	6	6	4	3	—	—
		3	2·15	30	14	5	5	$3\frac{1}{3}$	$2\frac{1}{2}$	—	—
		1	—	—	Decreases	Decreases	Increases	Increases	Increases	—	40
4	Ocean, long voyage	2	7·25	15	13	12	12	8	6	22	49
		3	10·75	30	14	15	15	10	$7\frac{1}{2}$	31	$52\frac{1}{2}$
		1	—	—	Decreases	Decreases	Increases	Increases	Increases	—	70
5	Ocean, voyage out and home.	2	1·45	15	19	12	12	8	6	30	91
		3	2·15	30	25	15	15	10	$7\frac{1}{2}$	50	105

(*To be continued in our next.*)

MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

An Account of some Experiments with a large Electro-Magnet. By Mr. Joule.—Professor W. Thomson, in Mr. Joule's absence, brought the subject before the section. The relation of the exciting force to the sustaining power of a magnet was the subject which it was the author's desire to examine, the laws arrived at being very divergent from those usually received. The soft iron made use of in this magnet was of such a nature that it always—probably on account of intense magnetisation on some former occasion—retained a residual polarity, which was always in the same direction. The magnet might be excited by a current which developed a polarity opposed to the residual one; but on the interruption of the current, the latter re-appeared. With high power, the lifting power fell short of being proportional to the square of the current; but with feeble excitation, Mr. Joule found the sustaining force to vary as the fourth or fifth power of the current strength employed.

Dr. Robinson gave an account of some of his own experiments on this subject, which confirmed those of Mr. Joule. The magnet made use of in his experiments consisted of two upright pillars of soft iron, with a moveable crosspiece of the same metal, which enabled him to vary the length of the limbs of the magnet. To determine the lifting power, a keeper, or sub-magnet, accurately planed, was placed across from pole to pole of the magnet, and, by a suitable mechanical arrangement, the force necessary to separate it from the excited magnet was determined. An approach to the point of magnetic saturation soon manifested itself, and, in this respect, the experiments of Professor Robinson were quite confirmatory of those of Mr. Joule.—Professor Tyndall remarked that he had sometimes been surprised to observe the comparatively low power of excitement in Mr. Joule's experiments at which the approach to magnetic saturation was exhibited. In Müller's experiment, where thick bars of iron were used, it required very strong excitation to produce the falling off from the law, that the magnetic attraction is proportional to the square of the exciting current. In Mr. Joule's experiments, masses of soft iron were made use of, of far greater size than those used by Müller; but, nevertheless, the falling off from the law alluded to soon exhibited itself. In the remarks which had been brought before the Section, the shape of the magnet was omitted as an element in the question; but, in all probability, it would be found that if one of the limbs of Dr. Robinson's magnet were employed alone as a straight bar, its magnetism being measured by its action upon a freely-suspended magnetic needle, instead of by its lifting power, the magnetic saturation of the bar would be much more difficult of attainment. Or even preserving the form of experiment made use of by Dr. Robinson, and introducing a plate of non-magnetic matter one-tenth or one-hundredth of an inch in thickness between the keeper and the magnet, a totally different law of lifting power would be obtained; the magnetic attraction in the last case would preserve its proportionality with the square of the current for a much longer period. A current which would appear to saturate the magnet in Dr. Robinson's experiments would not saturate it in the latter case; and there does not appear to be any sufficient reason for accepting the latter result in preference to the former, as expressive of the absolute capacity of the magnet for magnetisation.—Dr. Robinson observed in reply, that he believed his method of experiment preferable to that suggested by Professor Tyndall for the special object in view. He regarded the disruption of direct contact better calculated to throw light on the true state of the magnet than the separation of the keeper, where an interval existed between it and the magnet. He had actually introduced such an interval as that spoken of by Professor Tyndall, and it was true that he had found a totally different law from that arrived at when magnet and sub-magnet were in contact.

On the Radiant Spectrum. By Sir David Brewster.—The author communicated some remarkable experiments on what he termed the radiant spectrum.

Account of Experiments on the Force of Electro-Magnets. By Mr. J. P. Joule.

On the Effect of Mechanical Strain on the Thermo-electric Qualities of Metals. By Professor Thomson.

On Peristaltic Induction of Electric Currents in Submarine Telegraph Wires. By Professor Thomson.—Recent examinations of the propagation of electricity through wires in subaqueous and subterranean telegraphic cables have led to the observation of phenomena of induced electric currents, which are essentially different from the phenomena (discovered by Faraday many years ago) of what has hitherto been called electro-dynamic or electro-magnetic induction, but which, for the future, it will be convenient to designate exclusively by the term electro-magnetic. The new phenomena present a very perfect analogy with the mutual influences of a number of elastic tubes bound together laterally throughout their lengths, and surrounded and filled with a liquid which is forced through one or more of them, while the others are left with their ends open or closed. The hydrostatic pressure applied to force the liquid through any of the tubes will cause them to swell, and to press against the others, which will thus, by peristaltic action, compel the liquid contained in them to move in different parts of them in one direction or the other. A long solid cylinder of india-rubber, bored symmetrically in four, six, or more circular passages parallel to its length, will correspond to an ordinary telegraphic cable containing the same number of copper wires, separated from one another only by gutta percha; and the hydraulic motion will follow rigorously the same laws as the electrical conduction, and will be expressed by identical language in mathematics, provided the lateral dimensions of the bores are so small, in comparison with their lengths, or the viscosity of the fluid so great, that the motions are not sensibly affected by inertia, and are consequently dependent altogether on hydrostatic pressure and fluid friction. Hence the author considers himself justified in calling the kind of electric action now alluded to, *peristaltic induction*, to distinguish it from the electro-magnetic kind of electro-dynamic induction. The mathematical treatment of the problem of mutual peristaltic induction is contained in the paper brought before the Section; but the author confined himself in the meeting to mentioning some of the results. Among others, he mentioned, as being of practical importance, that the experiments which have been made on the transmission of currents backwards and forwards by the different wires of a multiple cable, do not indicate correctly the degree of retardation that is to be expected when signals are to be transmitted through the same amount of wire laid out in a cable of the full length. It follows, that expectations as to the working of a submarine telegraph between Britain and America, founded on such experiments, may prove fallacious; and to avoid the chance of prodigious losses in such an undertaking, the author suggested that the working of the Varna and Balaklava wire should be examined. He remarked that a part of the theory communicated by himself to the Royal Society last May, and published in the Proceedings, shows that a wire of six times the length of the Varna and Balaklava wire, if of the same lateral dimensions, would give thirty-six times the retardation, and thirty-six times the slowness of action. If the distinctness of utterance and rapidity of action practicable with the Varna and Balaklava wire are only such as to be not inconvenient, it would be necessary to have a wire of six times the diameter—or better, thirty-six wires of the same dimensions, or a larger number of still smaller wires twisted together, under a gutta-percha covering, to give tolerably convenient action by a submarine cable of six times the length. The theory shows how, from careful observations on such a wire as that between Varna and Balaklava, an exact estimate of the lateral dimensions required for greater distances, or sufficient for smaller distances, may be made. Immense economy may be practised in attending to these indications of theory in all submarine cables constructed in future for short distances; and the non-failure of great undertakings can alone be *insured* by using them in a preliminary estimate.

Elucidations by Facts and Experiments of the Magnetism of Iron Ships, and its Changes. By the Rev. Dr. Scoresby.

Experimental Observations on an Electric Cable. By Mr. Wildman Whitehouse.—After referring to the rapid progress in submarine telegraphy which the last four years have witnessed, Mr. Whitehouse said that he regarded it as an established fact, that the nautical and engineering difficulties which at first existed had been already overcome, and that the experience gained in submerging the shorter lengths had enabled the projectors to provide for all contingencies affecting the greater. The author then drew the attention of the Section to a series of experimental observations which he had recently made upon the Mediterranean and Newfoundland cables, before they sailed for their respective destinations. These cables contained an aggregate of 1,125 miles of insulated electric wire, and the experiments were conducted chiefly with reference to the problem of the practicability of establishing electric communications with India, Australia, and America. The results of all the experiments were recorded by a steel style upon electro-chemical paper by the action of the current itself, while the paper was at the same time divided into seconds and fractional parts of a second by the use of a pendulum. This mode of operating admits of great delicacy in the determination of the results, as the seconds can afterwards be divided into hundredths by the use of a "vernier," and the result read off with the same facility as a barometric observation. Enlarged facsimiles of the electric autographs, as the author calls them, were exhibited as diagrams, and the actual slips of electro-chemical paper were laid upon the table. The well-known effects of induction upon the current were accurately displayed; and contrasted with these were other autographs, showing the effect of forcibly discharging the wire by giving it an adequate charge of the opposite electricity in the mode proposed by the author. No less than eight currents—four positive and four negative—were in this way transmitted in a single second of time through the same length of wire (1,125 miles), through which a single current required a second and a half to discharge itself *spontaneously* upon the paper. Having stated the precautions adopted to guard against error in the observations, the details of the experiments were then concisely given, including those for "velocity," which showed a much higher rate attainable by the magneto-electric than by the voltaic current. The author then recapitulated the facts, to which he specially invited attention:—First, the mode of testing velocity by the use of a voltaic current divided into two parts (a split current), one of which shall pass through a graduated resistance tube of distilled water, and a few feet only of wire, while the other part shall be sent through the long circuit, both being made to record themselves by adjacent styles upon the same slip of electro-chemical paper. Second, the use of magneto-electric "twin-currents," synchronous in their origin, but wholly distinct in their metallic circuits, for the same purpose, whether they be made to record themselves direct upon the paper, or to actuate relays or receiving instruments which shall give contacts for a local printing battery. Third, the effects of induction, retardation of the current, and charging of the wire, as shown autographically; and contrasted with this—fourth, the rapid and forcible discharging of the wire by the use of an opposite current; and hence—fifth, the use of this as a means of maintaining, or restoring at pleasure, the electric equilibrium of the wire. Sixth, absolute neutralisation of currents by too rapid reversal. Seventh, comparison of working speed attainable in a given length of wire by the use of repetitions of similar voltaic currents as contrasted with alternating magneto-electric currents, and which, at the lowest estimate, seemed to be seven or eight to one in favour of the latter. Eighth, proof of the co-existence of several waves of electric force of opposite character in a wire of given length, of which each respectively will arrive at its destination without interference. Ninth, the velocity, or rather amount of retardation, greatly influenced by the energy of the current employed, other conditions remaining the same. Tenth, no adequate advantages obtained in a 300-mile length by doubling or trebling the mass of conducting metals. The author, in conclusion, stated his conviction that it appeared from these experiments, as well as from trials which he had made with an instrument of the simplest form, actuated by magneto-electric currents, that the working speed attainable in a submarine wire of 1,125 miles was ample for commercial success. And may we not, he added, fairly conclude also that India, Australia, and America are accessible by telegraph, without the use of wires larger than those commonly employed in submarine cables?

Provisional Report on Boiler Explosions, by Mr. Fairbairn, who said he had not been able as yet to make many experiments, but had a boiler made so as to determine not only the proportionate strength of boilers, but also to offer suggestions for their management. Their boiler was 17 feet in diameter, with two internal tubes, 3 feet in diameter. It had stood a pressure of 80 lbs. on the square inch, but at 100 one of the tubes collapsed. Their object was to discover a means of proportioning the strength of all the parts. It was also desirable to discover something as to the elastic force of steam, and its properties.—In reply to a question, Mr. Fairbairn said he had investigated no less than a dozen explosions, and there was in the press a series of papers, stating, so far as he knew, the causes. Sometimes they arose from gross negligence, but he believed the majority arose from excess of steam, and it was desirable to be able to proportion the strength of all the parts.

On the Operation of the Patent Laws. By Mr. J. Macquorn-Rankine.—He said the new patent laws have produced some benefits, as simplifying the means of procuring patents, the division of payments, and the speedy publication of new patents, &c. But he thought the facility with which patents are granted is an objection, as furnishing a means for foolish inventors to take patents under the new law; as also the fact, that as patents are provisionally registered for three months, the public cannot know what the character of a new invention is, and therefore more than one or two persons may take a patent for the same invention. Mr. Rankine pointed out several defects in the law of patents. The scope of the paper was to induce the Section to move for a reform in these laws.

On Artillery and Projectiles. By Mr. W. B. Adams.—Mr. Ward read this paper, which gave a description of various kinds of projectiles, and the philosophical reasons why gun-cotton is better for blasting rocks than for gunnery. The first guns in use in all countries were long; but the inconvenience of very long guns was the cause why the length was curtailed, and why also carronades and mortars were invented. The paper then went on to describe the material of which artillery should be made, and the proper mode of manufacture, and an improved trunnion, with some original suggestions regarding the form of wadding and shot best suited to give sure aim and increased velocity and penetration. In giving his idea of the best form of a ball, Mr. Adams thought that the conical form, with feathers, was the best, which is exactly that which Mr. Kennedey, of Kilmarnock, has lately patented, and which has been experimented upon lately at Ardrossan and Troon. The idea of an elongated ball, which should also be charged like a bomb, has also been anticipated by Mr. Kennedey. Welded guns, united by hydrostatic pressure—the coating inside with another metal to prevent abrasion—and several other improvements, which have in part been adopted by inventors, were also recommended.

Dr. Robinson was of opinion that feathers upon a ball was a mistaken idea, because the ball carries with it a portion of air, and that rotation could not be secured to the ball by feathers alone, as they could not act but on the body of air which they carried with them. Rifled guns are more liable to burst, because the force necessary to explode a ball from such a piece of ordnance is much greater than that required for a plain bored gun; and also that a rifled gun is much more liable to burst, or be rendered useless from frequent discharges, because of the force necessary to cause rotation having to be added to that which causes projection. Dr. Robinson alluded to the bronze guns of the Dardanelles, which are of three feet bore, used against our fleets not many years since, and which were made by Mohammed II., and asked whether bronze might not now be used instead of cast-iron. He suggested the probability that on experiment railway-iron might be found better than cast-iron for ordnance.—Mr. Fairbairn said the material of which guns were made was not so good as it was fifty years ago. He was present at Woolwich this week, and saw the practice of the guns there. One of them seemed properly moulded in every part, but it was found that the welding in one part was not sound, and the gas getting into the fracture operated just like a wedge, and split it as if it had been made of paper. Another was formed of steel bars, with a breech of cast-iron attached to it. The breech was entirely blown off the gun, and the bars torn asunder. It appeared to him absolutely necessary to have such a material as would not only resist the severe impulse which the discharge of the shot caused, but be perfectly solid in the mass. If they were made of parts, such as the staves of a cask, these opened, and the result was the fracture of the gun. The Stirling gun was a mixture of wrought with cast iron, and it certainly carried one-fourth or one-fifth more of common pressure; but when applied to artillery under Colonel Dundas, after a few rounds the pieces were burst. The mode of casting these large guns is also defective. They were generally cast solid, and in the cooling the metal was left exceedingly porous in the centre, and when one began to bore out the gun, one found it was not of so close a texture inside as out. Now they took the precaution of having cores in the middle, through which they sent a current of cold water to cool the inside simultaneously.—Dr. Robinson: About a century ago they cast them hollow, and it was thought a great improvement to cast them solid.—Mr. Fairbairn believed if they went about the work more carefully, they would arrive at a safer and better mode of casting than at present. If the mortars were made a foot longer, he believed, instead of sixty pounds, fifty pounds of powder would carry a shell of the same weight, and to a greater distance, and with greater accuracy. He thought, in the mortars, a great quantity of the metal was in the wrong place in a great many cases. They had the same thickness of metal at the mouth as at the breech, whereas it might taper without any danger, the pressure being less at the mouth. He explained an ingenious ball, in which there was a spiral tube, so that the ball with an ordinary gun suited all the purposes of a rifle; but he did not know whether the experiment was successful or not. Till lately guns of the ordinary calibre would stand 600 or 700 rounds before they were injured, but they always gave way at the vent. But they got into a plan of putting a tube into the vent, which made them stand 600 or 700 rounds more. Now-a-days the same guns would not stand 100 rounds; perhaps the reason was that the metal was not properly selected. He believed the subject was now before the authorities at Woolwich, of what caused the explosion at Sweaborg, and he hoped it would lead to better material, or a better selection.

The iron procured by hot blast is excellent for machinery purposes; but he did not think it the best for artillery. With regard to the Turkish artillery, he was at Constantinople some years ago, and they are almost all made of a mixture of brass and tin. Mr. Mare, at Blackwall, is now constructing a gun three feet in diameter, the breech of cast-iron, and the tube of direction of wrought-iron. Whether it would answer or not, he did not know.—Dr. Robinson: The bronze guns failed in a very remarkable manner. The ball rises on firing, is deflected on the gun, and if the gun is long it is again deflected, and deep holes are made in the barrel, owing to the softness of the metal. Could not a thin lining of steel or wrought-iron be inserted into the tube?—Mr. Fairbairn thought it was very difficult to form any gun that differed in its parts. He would prefer to have a gun perfectly solid—of steel, if they pleased; for he had seen excellent specimens of steel manufactures from Prussia in the Great Exhibition, and well calculated for making field artillery. The artillery of the present time was much larger than it was in former times, and allowance must be made for that. The Government was endeavouring at present to get charcoal-iron from Nova Scotia, and there were large supplies of wood and iron in the Bay of Fundy.—Mr. Lawrie proposed to have no vent at all, but to fire in the manner in which rocks are blasted, by means of galvanism. This would prevent wearing at the vent. He hoped artillery would be brought to perfection, for as weapons had improved war had decreased in brutality; and he hoped there would be a good stand-up fight for it, in order that they might have a lasting peace.—A Member stated that some hydrostatic presses had been made of cast-iron, with a case of wrought-iron, at Mr. Downie's works, Glasgow, and had stood an immense pressure, but they had not as yet tried it on guns.—Mr. Fairbairn asked if the gun made at Mr. Downie's had been cast in such a way as to cause an amalgamation of the cast and wrought iron? If that were the case, he had no doubt it would secure great strength. He had a doubt, however, that there was a difference of ductility, which would cause separation. It had occurred to him that they might be cast under extreme hydrostatic pressure. They had cast them at Woolwich with 19 feet of iron on the gun, but he did not as yet know the result.—Mr. Sykes Ward thought a gun could not explode so readily if the powder did not impinge directly on the ball.

Report on the Present State of our Knowledge of the Supply of Water to Towns. By Mr. J. F. Bateman.—After alluding to the interest which attaches to the consideration of this question, and its importance as affecting the health, the comfort, and well-being of the inhabitants of large towns, Mr. Bateman remarks that, till a very recent period, the question of water supplies on a large scale has in this country been much neglected. The works, however, now designed and carried out are amongst the largest, the boldest, and most successful productions of the age, rivalling the greatest undertakings of the ancients and the Romans. Towns are now almost universally supplied with an unlimited quantity of water in the most perfect and convenient manner, the water being conducted into the interior of the houses, and thus applied to every domestic want. Towns were formerly supplied by artificial means—by the collection of springs, which were conducted to public fountains, from which the inhabitants fetched water as they required it. The supply to Rome on this system is said to have amounted at one time to 50,000,000 cubic feet per day to 1,000,000 inhabitants, which is upwards of 300 gallons a day to each person. After glancing at the early attempts in this country to procure water by artificial means, he shortly described the manner in which Peter Morice, a Dutchman, first raised water from the Thames for the supply of London, in 1581, by means of water-wheels worked in the arches of Old London Bridge, and the construction of the New River Works, by which water was brought to London from Hertfordshire by Sir Hugh Middleton—a distance of 40 miles—in the beginning of the 17th century. He stated that London is now supplied with water by nine companies, who deliver about 44,000,000 gallons per day, and derive an annual revenue of about £236,000. He then went on to say, that the different sources from whence a town can derive a supply of water, beyond that which the inhabitants can collect in cisterns from rain, or procure by wells on their own premises, may be classed as follows:—1st, From springs; 2ndly, From Artesian wells, or from water to be obtained from absorbent geological strata; 3rdly, From rivers; 4thly, From gathering grounds, where the surplus water of wet seasons is collected into large storage reservoirs; and 5thly, From natural lakes.

1st. *Spring-water* varies materially in its quality, according to the geological character of the rocks through which it passes or through which it issues. It is generally excellent as a beverage, but frequently, from its excessive hardness, unfitted for domestic use. Thus, most of the primitive rocks, and many of the secondary ones, yield soft water of excellent quality, while limestone, chalk, the old and new red sandstone, the lias and oolite, all yield waters of a hard description. Rain-water freshly caught in towns is generally from 1° to 2° of hardness. The springs from granite, mica, slate, millstone, grit, and the greensands, as they are developed in Surrey, vary, with some exceptions, from 1° to 3° of hardness; the springs from the new red sandstone, from 5° to 20°; limestone and chalk, from 10° to 20°; and those from the lias and the oolite run up to 30° and upwards. The *quantity*, too, of spring-water from any given area varies according to the geological character of the country. Absorbent measures, such as sand, gravel, chalk, and limestone, yield springs in greatest abundance; next, the more loosely stratified rocks, such as the coal-measures and the millstone grit; last of all, the slates, the Silurian rocks, and the primitive formations. Supplies of towns by spring-water, and various instances of large springs, were adduced. The most abundant supply of spring-water, from an extended area, was stated to be in the greensand formation near Guildford, in Surrey, where between 30,000,000 and 40,000,000 gallons of water per day, not exceeding 2½° of hardness, might be produced for the supply of London. Various particulars as to the yield of other geological measures were given, from extended observations in many parts of the country.

2ndly. *From Artesian Wells.*—This is a system of obtaining water largely resorted to in the neighbourhood of London, in the north of France, and in other places where the geological conditions of the country are favourable to its adoption. It is adopted where absorbent measures containing water derived from distant elevated points are covered by other measures of an impervious or retentive character. A bore-hole is sunk through the impervious upper stratum to the water-bearing stratum below. As soon as the water is reached, it rises through the bore-hole to the surface, the quantity of water yielded depending upon the pressure and the rise of the bore-hole. The Artesian well at Grenoble, in France, yields 880,000 gallons per day; fifteen wells at Tours, in France, yield about 4,000,000 gallons daily; and it is estimated that the quantity obtained in this way in London and its immediate neighbourhood is equal to 8,000,000 or 10,000,000 gallons per day. The supply derived from wells in the new red sandstone was then adverted to, the particulars of supplies yielded at Liverpool, Wolverhampton, and other places, being given. At Liverpool, according to the report of Mr. Robert Stephenson in 1850, seven wells yielded about 3,900,000 gallons per day. The quantity of rain which penetrates the ground, and the probable yield in different districts, according to the annual rain-fall, or the permeable character of the rock, were investigated; and it was shown that, except where the rain-fall is large, no great supply of water could reasonably be expected from wells in the new red sandstone. The hardness of the water varied generally from 5° to 20°.

3rdly. *From Rivers.*—Rivers have been naturally and largely resorted to for the supply of towns, and still contribute to the wants of many important places; but, as agricultural improvements, population, and manufactures extend, they are gradually becoming unsuited to the purpose, and are being abandoned for purer sources.

4thly. *From Gathering Grounds.*—From these sources the most important supplies of modern times have been procured. Many points of considerable interest enter into this branch of the subject;—the annual fall of rain—the loss by evaporation and absorption—the quantity of water flowing off the ground or issuing in springs—the duration of droughts—the heaviest falls of rain, and the capacity of reservoirs. Mr. Bateman entered largely into these questions, showing that the rain varied from 20 inches to nearly 200 inches per annum, according to locality; that from 12 to 16 inches of that which fell was lost by evaporation, vegetation, &c.; and that the storage capacity of reservoirs should vary from 20,000 to 60,000 cubic feet and upwards, according to the annual rain-fall, for every acre of collecting ground. He gave the particulars of the Manchester, the Liverpool, and other waterworks in this country—the Croton Aqueduct for the supply of New York, in America—the Boston Waterworks, &c., together with some information upon filtration, and the methods adopted for separating pure water from that occasionally discoloured.

5thly. *The supply from Natural Lakes.*—This mode of supply, where it can be adopted, has many recommendations from its extreme simplicity. The towns of Whitehaven, Dumfries, and Inverness are supplied in this way, and Glasgow is to be supplied from Loch Katrine. Objections have been taken to the extreme purity of the water, in many cases of lake supply, from its action on lead; but the late investigation in the supply of the Loch Katrine water to Glasgow has pretty clearly demonstrated the safety with which such water can be supplied for domestic purposes, even through leaden pipes.

On some Features in the Geology of the United States, illustrated by a new geological map. By Mr. H. D. Rogers.—The discussion on this subject was very lengthy.

Note on a recent Geological Survey of the Region between Constantinople and Broussa, in Asia Minor, in search of Coal. By Mr. H. Poole.—Communicated by Sir R. I. Murchison, with the permission of the Earl of Clarendon.

On the Superficial Deposits laid open by the Cuttings on the Inverness and Nairn Railway. By Mr. G. Anderson.

On the probable Maximum Depth of the Ocean. By Mr. S. V. Wood.

GREENSHIELDS' PATENT SELF-KEYING CHAIR.

This chair was designed to give a more secure mode of holding the rail in joint, intermediate, and other chairs; to give increased security, and insure a continuity of evenness of surface, cant or slope of the rail, and uniformity of strength throughout the whole length of the line.

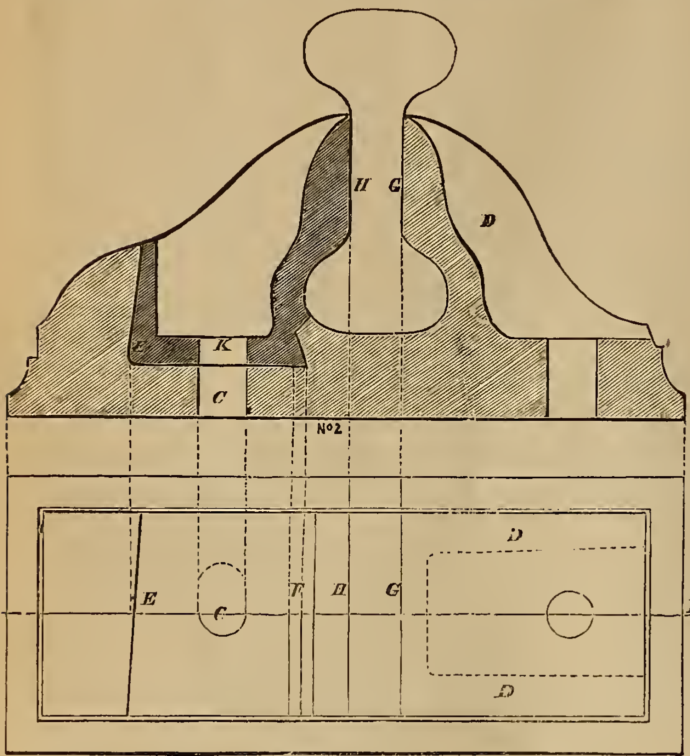
No. 1 is a plan or sole of the chair, cast in one piece: for an intermediate chair, the angle formed by the line E is sufficient for the ordinary variations in the thickness of the rail. The part marked F is always to be made parallel to the line E; the lines H and G are to be made at right angles to the side of the chair.

No. 2 is a section on the line A B on the plan No. 1, showing the parts in elevation and section; the part tinted being in section, the darker showing the sliding bracketed piece, to be cast separately. The faces of the jaws of the chair, H, G, are to be made of the slope or cant required to be given to the rail.

The bracketed piece slides upon the sole between the dovetails, E and F; and as it slides, it tightens against the butment-piece, E, and the side of the rail, H, and is driven up until the rail is firmly held between the jaws of the chair, H, G, similar to being held in the jaws of a vice; and by this means the percussion or blow from trains passing is more equally distributed over the sole or base, instead of the principal force being thrown on a limited space in the centre of the chair of ordinary construction. When the bracketed piece has been driven up sufficiently to secure the rail, a pin or bolt is passed through the hole K in the bracketed piece, and the hole c in the sole, and then driven or screwed into the sleeper, and by this means is secured from shifting.

The joint-chair is constructed with two bracketed pieces, one sliding

GREENSHIELDS' PATENT SELF-KEYING CHAIR.



from the left and the other from the right hand, the sole or base being made in one piece of sufficient width to receive the two bracketed pieces. Each piece is secured by a pin or bolt, the same as in the intermediate chair. By this means, a rail can be laid or turned without disturbing or loosening the keys of the adjoining rails. For light traffic, the joint-chair can be constructed with a wider sole or base than for an intermediate chair, and with one bracketed piece.

By the self-keying chair, the rail is firmly held and secured in the position to insure a safe and smooth surface for transit. The next requirement is that the chair be securely fixed upon a material possessing some amount of elasticity, and having little liability to expansion and contraction.

Wooden sleepers present the cheapest means of complying with the required conditions—wood possessing sufficient elasticity to lessen the injurious effects produced by the percussion or blow from trains passing over the points of support, when unyielding stone blocks, iron sleepers, or other non-elastic materials, are the medium of support.

The expansion and contraction in a transverse wooden sleeper does not alter the width of the gauge in a degree to produce any injurious effect.

It is an indispensable condition that the chairs or other efficient means of holding or bearing the rail be fixed upon a material possessing some amount of elasticity, to perfect that smoothness of transit so essential to insure safety, and, by lessening the effects from percussion, increase the durability of the rails, engines, and other rolling stock.

The means that have been used to increase the durability of wooden sleepers have in most cases disintegrated the fibrous structure, and in all destroyed the elasticity, reducing the material to a condition approximating in effect to the unyielding stone blocks, iron sleepers, or other non-elastic material. The preservation of the wooden sleeper must be effected by means that will not destroy the efficiency for lessening the injurious effects from percussion.

The construction of the self-keying chair is simple, does not require fitting, and securely holds the rails in the position required; insures uniformity of strength in the joint, intermediate and other chairs, and an even uniformity for transit.

The cost for joint-chairs is less than for securing the joints with plates and belts; and for intermediate chairs, not more than for chairs in ordinary use.

A saving is effected by the chairs not requiring compressed wooden keys, nor the expensive supervision and renewal of keys incurred in keeping them wedged up; and the costly and serious consequences arising from the wooden keys becoming loose and displaced are prevented.

The joint, intermediate, and other chairs can be fixed to rails already laid with the same facility as fixing an ordinary intermediate chair.

CHAMPION'S IMPROVEMENTS IN STEAM-BOILERS AND FURNACES.

(Extract from the Patentee's Description.)

Fig. 1.

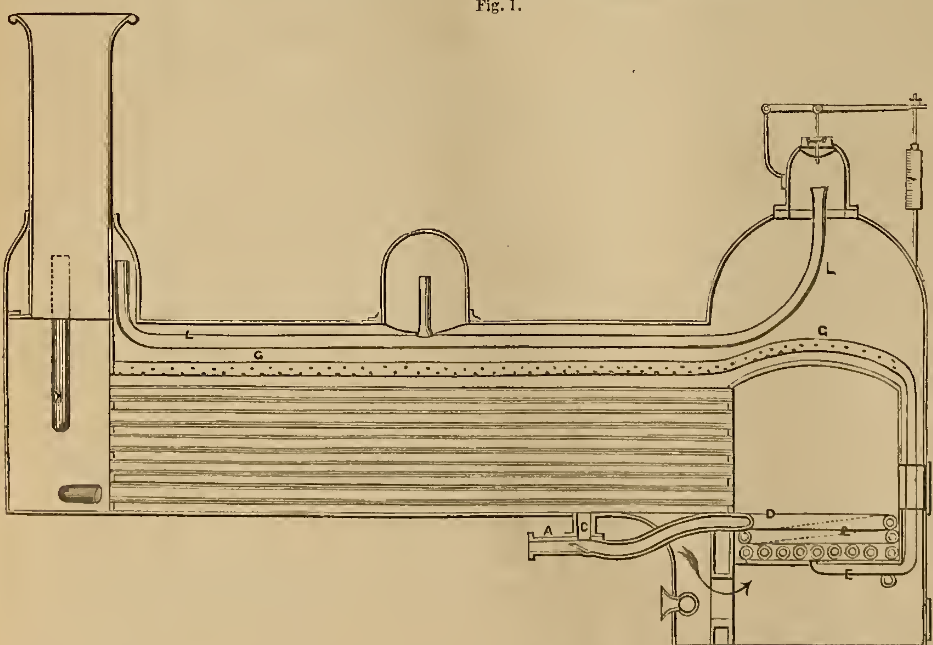
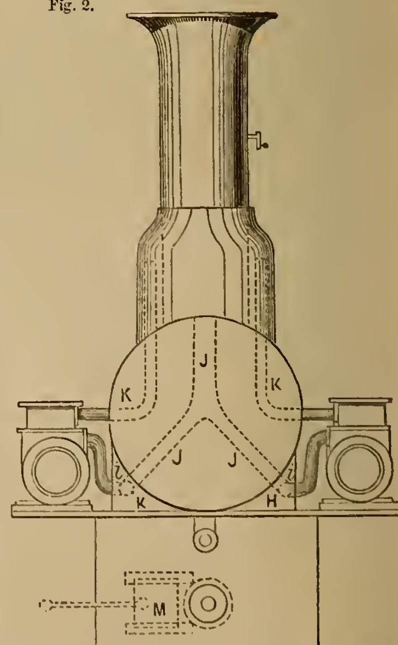


Fig. 2.



"Fig. 1 is a vertical longitudinal section of a locomotive boiler, showing the furnace and feed-water arrangement, through coils, scroll-grate, and sprinkler; and Fig. 2 is a transverse end view, showing the cylinders with their attachments and direct-action exhaust steam blast, applied to a locomotive, but they are applicable to all boilers. In Fig. 1, the new mode of feeding the water, and keeping up a rapid circulation through the coils and sprinkler, is shown. A is a pipe to which the feed-pump or supplying-pipe is attached. B is a valve in said pipe, hinged above at its junction with pipe C, which intersects with the boiler at or near the bottom, or with a leg or water-space. D are coils, or the extension of pipe A around the furnace to preserve the plates, forming sides or a basket for the coal above the grate, after which it may be further convoluted into a scroll-grate, E, the convolutions of which regularly wind from the outer coils or sides to the centre, from which point the pipe F starts, passing into the water-space and up above the fire-box or flues, where it enters or becomes the sprinkler G, which extends through the length of the boilers, above the furnace, or tubes, or flues. The sprinkler is pierced with a series of small apertures at the proper angles, to sprinkle any part or the whole of the surface where the fire is acting on the opposite sides of the metal when bare of water. While the pump is feeding, or the supply passing into the boiler, the valve B will rise by the pressure under it, closing the pipe C, and the feed-water will pass on through the coils, grate, tube, and sprinkler, entering the boiler highly heated; but should the pump fail to supply, the steam and hydrostatic pressure in the boiler and pipe C will open the valve B, and admit the water from the boiler into the coils; and the intense heat to which these coils are subjected, creates an extra pressure in the tube, and the vaporific tendency therefrom causes the water in the tube to pass upwards with continuous rapidity through the sprinkler, jetting or showering the plates, whether the pump is feeding or not. And so long as any water remains in the boiler above the valve C, the sprinkling of the fire surface plates will be continuous, and thus all the water may be evaporated, the steam exhausted, and the engine stopped, without any explosion taking place, or even injuring the boiler, provided the fire is extinguished as soon as the engine shows signs of stopping. By this mode of feeding and circulating water in steam-boilers, the amount of water need not be more than one-third the usual quantity, and the evaporation thus rendered three times more effective—important items in steam navigation and locomotion. In building new boilers for stationary engines, they need not be much above half the usual rise, as the whole boiler may be enveloped in the furnace, except a small dome or drum to take dry steam from.

"The mode of feeding cold water through the coils round next to the fire-box plates, prevents their destruction, by the intense heat that they are otherwise subjected to; and the jointless scroll-grate saves much heat and loss in replacing burnt grate-bars.

"In Fig. 2 is shown the triangular flues and pipe for the direct-action exhaust steam blast therein, with a closed stack, ash-pit, and furnace, after steam is up and the engine in motion, exhausting, propelling, and commingling all the heat, smoke, air, steam, and gas, round and round, through the tubes, triangular flues, then up through the grate, round again and again, until all are consumed by perfect combustion. By this mode of returning the heat by the blast under the boilers of locomotives, more surface is also exposed to the action of the fire in the triangular flues H H, as shown in Fig. 2, parallel with the centre of the sides and bottom of the horizontal part of the boiler, for the return of the unconsumed heat, smoke, and gas to the ash-pit beneath the grate, that will escape through the tubes to the smoke-box, from whence it will rush into the vacuum formed in the triangular flues by the exhaust, and by the next puff of the exhaust from the pipes *i i*, will be forced along the two triangular passages, commingling the exhaust with the products of combustion, becoming part and parcel thereof, small supplies of fresh air being admitted by an inlet pipe through small apertures, between each puff of the exhaust, in small jets, giving life continuous to the fire. Additional pipes, J J, are attached to the pipes *i i*, for the escape of a portion of the exhaust steam into the atmosphere through a valve should it exert too much force on the fire when running at the greatest speed. There is a pipe, L, conveying dry steam from the main and centre dome to the dome or space that surrounds the stack, from which the steam-pipes K K supply the cylinders. M is a damper to close the opening or openings between the triangular flues and ash-pit while the fire is starting and steam rising, after which the damper in the chimney and the ash-pit doors must be closed, and the damper M opened: this saves the heat of the fuel, exhaust steam, health, eyes, and clothing of the passengers from the purgatory of smoke, sparks, and fine dead particles of fuel which are now emitted from the smoke-stacks of locomotives, even where the most approved spark-arresters and ventilating cars are in use."

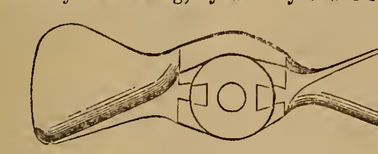
H., *New York.*

CORRESPONDENCE.

IMPROVED SCREW.

To the Editor of THE ARTIZAN.

SIR,—We have patented an improvement in the screw-propeller, and I enclose you a drawing, by which you will see we make it in three segments



instead of a whole casting, and fit them together upon the dovetail principle. Spare blades can be kept on board, and fit in case of accident in a short time; and by trimming the ship, in many cases, without docking, also save the trouble of withdrawing heavy shafting. The blades made of wrought-iron will be much cheaper and handier than making a whole screw, and pitch altered at any time at little cost. The boss will last as long as the ship, and blades fitted with tallow will not corrode.

Should you consider it worth notice, we hope you will give it a place in your next publication.

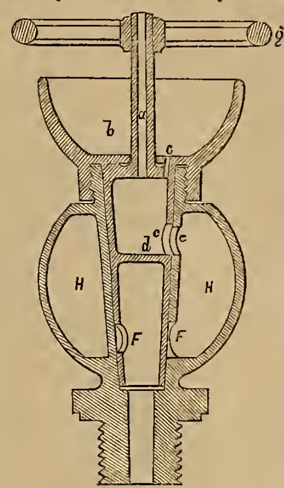
Yours, &c., W. E. KENWORTHY & Co.

Leeds, Sept. 27, 1855.

LUBRICATOR—METALLIC PACKING.

To the Editor of The Artizan.

SIR,—I have enclosed for insertion in your valuable work, THE ARTIZAN, should you think it worth your notice, a plan of an oil or grease cock, for giving or admitting oil or tallow into a cylinder or slide-valve casing, or any other vessel that may contain a pressure. I am not aware of any cock of this description having been introduced by any other person, although there are cocks of various kinds introduced for the same purpose.



LUBRICATOR.

DESCRIPTION. — *a*, small hole in the stem or plug for the air to escape whilst the oil or hot tallow is being poured in; *b*, cup screwed on to the top of the cock to receive the oil; *c*, hole for the admission of the oil, which has to pass through the hole *e*, into the chamber, H H: *d* is a partition in the plug or stopper. After the chamber, H H, gets filled, the passage F in the plug will require to be turned round until it becomes opposite the passage F, which allows the oil to pass into the cylinder or valve casing, during which time the top passage, *e*, is closed. *g*, small wheel fitted on the top of the plug.

I have also enclosed a plan of a metallic stuffing-box, similar to one which I applied to an engine in Russia in 1851. It is drawn *half size* (2-inch scale), and answered the purpose better than any packing I have ever seen or heard of. It had been at work four years and a half previous to my leaving that country, and had never been taken out of its place; and I consider that if stuffing-boxes for piston-rods were made in this way, they would give but little if any trouble, and be a great saving to the owners—that is, if made in a proper manner. It is well known to all engineers that have charge of steam-engines, that unless great care is taken where hemp or flax gasket is used for piston-rod stuffing-boxes, the piston-rod is very liable to become grooved.

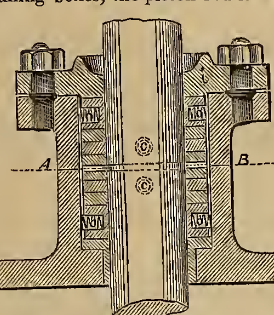


Fig. 1.

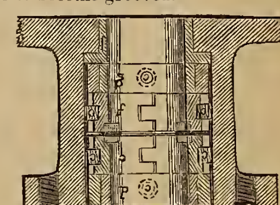


Fig. 3.

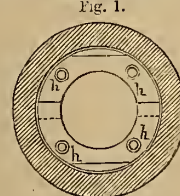


Fig. 2.

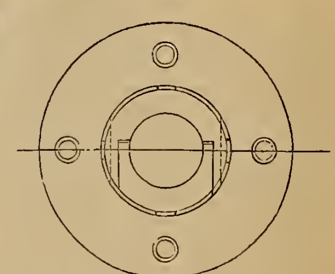


Fig. 4.

The following is an explanation of the drawing:—

Fig. 1, sectional elevation; Fig. 2, section through A B; Fig. 3, section with piston-rod and gland removed; Fig. 4, plan of ditto.

This metallic packing consists of four rings of *cast-iron*, *d e f g*: each ring consists of two pieces, and each half or piece has a spiral spring, marked *c*, which is let into a recess as shown on plan, and which presses against the inside of stuffing-box, and keeps the rings tight against the piston-rod.

There is a space between the rings *e f*, and each ring is recessed to receive springs, marked *h h h h*: by that means the top and bottom rings are pressed hard against the upper and lower surfaces, *i j*. *i* is what may be termed a flange, with a cup cast on it to contain tallow for lubricating the piston-rod, and which is let into the stuffing-box about one-sixteenth of an inch, and ground on its place, so that no steam can escape between the two flanges.

Hayle, Cornwall, Sept. 18th, 1855. THOS. MERITON.

ON DESIGNING PUBLIC AND OTHER BUILDINGS.

To the Editor of The Artizan.

SIR,—The blunders observable in many costly works, as well as in petty ones, seem to have been caused by a want of due consideration of the *desiderata* respecting them; whilst, on the other hand, where the object to be attained has been considered before the commencement of the work, its end has been fulfilled.

The New Palace at Westminster has been abundantly criticised, as having failed in the chief *desiderata* in such a structure, such as seats for the greatest number of Members of Parliament ever likely to assemble, as well as in many minor particulars. It was not so with the works invented or introduced by Sir Samuel Bentham, for he was in the constant habit of collecting and writing down every service that might be desired from the machine or work previously to attempting its execution; and it was from this mode of proceeding that success attended all his measures. For instance, the caisson in Portsmouth Dockyard was found to answer its intended purpose at the very first time of trial; so did his steam-dredging apparatus, which, from the very first, excavated and brought up from under water at a less expense than any other steam-dredger since used, though half a century has elapsed since its first invention by Sir Samuel Bentham. Sir Samuel also stated to the Navy Board, in relation to his plan for Sheerness, that a view of the *desiderata* of a work was necessary for those persons or authorities on whose decision might depend the execution of the work, or any amelioration of it. His "Desiderata in a Naval Arsenal" has been published, but is long since out of print; and, as it affords an extensive example of the many considerations which ought to be entered into in the planning of great works, it may be said, private as well as public, possibly your readers may not think a copy of that paper misplaced in your pages, particularly as it indicates many particulars of essential importance to the health, comfort, and prosperity of the operatives and others engaged in large manufactories. It may be noticed, that some of the articles relate to political economy, and indicate the ameliorations desirable, the first article especially, which provides for a change, now happily commenced, of rendering all the war departments co-operative.

In the instance of Sheerness Dockyard, Sir Samuel's plan was not adopted: his office having been abolished towards the end of the year in which the renovation was desired, the works of that dockyard were entrusted to a private engineer.

On reference to the "Desiderata," article 8 will be found of considerable importance in private establishments, as materially facilitating the "taking of stock." This operation is generally too much neglected in private concerns, on account of the trouble it gives, and, indeed, the injury to the goods themselves. For instance, in Plymouth Dockyard, after charcoal ceased to be used, that remaining in store had to be measured as "taking stock:" part of the charcoal was broken and lost on each occasion, till at length no charcoal remained.

Article 10 indicates the expediency of drying wood artificially, which has been adopted in some large manufactories with great advantage, but which has not hitherto been sufficiently availed of; and hence arise the cracks in most common furniture.

But it seems superfluous to particularise the several articles that are applicable to private trade. Suffice it to say, that in these "Desiderata" will be found most, if not all, of the details on which the health and well-being of operatives depend, no less than what is conducive to the prosperity of the master.

October 13*th*, 1855. I am, &c., M. S. Bentham.

[Note.—We shall in our next give some extracts from the late Sir Samuel Bentham's very interesting work on the subject of "Desiderata in a Naval Arsenal," &c., forming Naval Papers No. V., as they apply admirably at the present time.—Ed.]

HOARE'S IMPROVEMENTS IN THE APPLICATION OF THE SCREW-PROPELLER.

To the Editor of The Artizan.

Sir,—In your last number there appeared a letter from Mr. John Truran, questioning the advantages of my application of the screw-propeller, &c. I am only too glad to have the opinion of practical men on my invention, and therefore have much pleasure in replying to Mr. Truran in your columns.

He says, "if the propeller and shaft are at an angle to the body of the vessel, as Mr. Hoare proposes applying them, a considerable amount of the power of the screw is lost, and that in the same ratio as the tendency of the screw to lift the stern of the vessel out of the water; and it will be found in all cases that the power thus lost more than balances that gained by the working of the screw in deep water." Here, I contend, Mr. Truran is quite in error, as I will endeavour to show; viz., a certain power is exerted by the engine on the screw, which acts on a certain fulcrum—the water. Either the water must leave the screw, or the vessel be propelled in proportion to the power applied: something must go, one or the other. Now, with the screw in a horizontal line near the surface, the water gives; it is thrown away from the screw, and, consequently, part only of the power of the engine actually gives propulsion. If we can prevent the possibility of this, it stands to reason all this power so lost becomes available. By my application,—that is, by driving on an angle downwards,—the tendency of the force is to lift the vessel bodily, and ahead.—It does not lift the stern only, as Mr. Truran supposes, the power being directed towards the centre of gravity.—As she cannot be lifted out of the water, she must go forward in proportion to the power applied; or if, where there is great power, she is lifted at all, it will only tend to lessen her displacement, and in the same ratio the resistance to her progress; and unless the angle is very great, I apprehend there will be no loss of power. Then, as in consequence of the deep immersion the fluid acts at all times with an equal force on each blade of the screw, there will be little or none of the vibratory motion so objectionable in screw-steamers, the cause of great wear and tear, and increased working expenses.

I will not take up your time by showing that, if we save power, we save space, as a small engine would then do the work now performed by a larger one; but I cannot close this letter without a remark on Mr. Truran's charge of inconsistency. With all due deference to him, I am not inconsistent. I said in my last letter, "two screws on this principle may be applied with advantage to the after body of a vessel;" and as there are certain forms of a vessel in which it would be an advantage to apply two screws, I think my application is the best mode of doing so. I may also mention that the volume of water between the side of the vessel and the propeller has nothing to do with propulsion, which is given by the direct thrust.

I had hoped to be able to send you the results of Mr. Wyld's experiments, but that gentleman informs me that he cannot supply them in time. They must, therefore, be deferred until the following number, and

I have the honour to be, Sir, &c., D. J. Hoare.

R. T. Y. Club, Bedford Hotel, Covent Garden, Oct. 8*th*, 1855.

NOTES AND NOVELTIES.

Department of Science and Art.—The second annual report of the Department of Science and Art has been issued. The progress made during the year will be seen from the following summary with which Dr. Playfair brings his report to a close:—

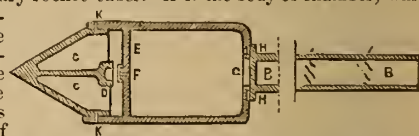
"In reviewing the state of the department for the past year, it may be observed generally that it has made a marked advance in extending instruction in art to elementary schools, 10,500 children having received such instruction through its agency. In concert with the Committee of Council on Education, it has enabled 1,044 teachers of public schools to learn drawing at the local schools of art, with a view to introducing it into their own schools; and 1,270 masters, who are at various training colleges throughout the kingdom, have been examined for certificates in elementary drawing. Means of illustrating the course of instruction have been widely spread, and, in addition to the trade supply, 294 schools have obtained examples through the department at an average cost of six guineas for each school. The local schools throughout the provinces have been attended by nearly 20,000 persons, chiefly artizans. The museums of the department have been visited by above 204,000 persons, and the art library at Marlborough House by nearly 8,000. The exhibition of students' prize drawings in the provinces has been inspected by above 66,000 persons. The Botanical and Zoological Gardens in Dublin have had above 135,000 visitors. The central schools in London continue to be made as useful as possible to the schools throughout the kingdom, and have been the means of providing well-trained masters for the provincial schools. The public services connected with the department continue in an active state, and, in the case of the Mining Record Office, and Office for the Discussion of Meteorological Observations, have had a largely-increased development during the last year. In regard to the financial expenditure of the department, every effort to economy has been made; and, of the aggregate sum of £79,846 8s. 6d. voted last year, it is expected that upwards of £17,000 will be paid back to the Exchequer at the close of the financial year."

Quartz Crushing.—When replying, in our August number, to the inquiry of our Correspondent on this subject, we did so in perfect candour, and are satisfied therewith; albeit we find ourselves betrayed into a repetition of the name of a gentleman which was introduced into the inquiry. It is quite possible that Mr. Goodall may be most intimately acquainted with the requirements for mixing blue pill, or for "grinding sugar, cocoa, mustard, pepper, jalap, *et hoc genus omne;*" and his machine may be, and we believe is, fully equal to such a task: yet we take leave to remark, that possibly the great question of Quartz Crushing has not yet come under that gentleman's notice in all its practical bearings, and therefore he must be content with the opinion of those who have experience to guide them, even if their opinion should happen to differ a little from his own modest estimate of his own production. Perhaps he will approach our estimate of the capabilities of the mill, whenever he recognises the difference between the physical character of blue pill and gold-bearing quartz.

New Gun and Mortar Boats.—We understand the Admiralty are making extensive arrangements for building and equipping a numerous flotilla of gun and mortar boats for next year's campaign. Messrs. Briggs, of Sunderland, have just laid down four of great length and light draught, to be fitted with screw-propellers and heavily armed. Messrs. John Scott and Sons, of Greenock, have laid down six mortar-boats, to be ready by March next. They will be about 70 feet in length, of light draught, and armed with 13-inch mortars, fitted on a patent platform placed amidships, and will be rigged in the cutter style.

PERCUSSION ROCKET.

This rocket is designed to explode the charge on striking the object aimed at, and is to be fired from ordinary rocket-tubes. H is the body or chamber, which is to be filled with gunpowder, or any other explosive material, through the aperture G, and then the flange H of the tube B is to be bolted over. Fitting strips are to be cast on the back of the chamber A, and then planed together with the face of the flange H.



The tube B B is filled with the ordinary rocket-charge, and then placed in the rocket-tube with the head projecting. To effect rotation, holes, I I, are cast obliquely to the tube B B.

The cone C C is secured by hardened steel screws, K K, to the body, A; the partition E E has a nipple, F, screwed into it, on which a percussion-cap or any other detonating mixture is placed; so that when the cone C C strikes an object, the screws K K break, and the hammer descends on the percussion-cap, which communicating with the powder in the chamber, explodes it. H. T. H.

NOTICES TO CORRESPONDENTS.

Robert Caldin and "Navvy."—The Earthwork Table referred to by you is by Mr. Joseph L. Gallot, and published by Messrs. Hodges and Smith, of Dublin. It is an excellently-contrived and neatly-executed sheet, by which, with great rapidity, quantities can be calculated for all lengths, bases, and slopes.

DIMENSIONS OF NEW STEAMERS OR SAILING VESSELS.

THE NEW IRON DOUBLE-BOWED RIVER PADDLE-STEAMER "SIR COLIN CAMBPELL," NO. 772.

Built and fitted by Mr. John Barr, engineer and iron shipbuilder, Glasgow, 1855.

Dimensions (per United States' Act)	ft.	in.
Length extreme over stems ...	166	7
Breadth of beam	17	5
Ditto, including paddle-cases ...	33	11
Depth of hold at midships ...	7	1
Length of engine-room	43	0

Tonnage.	Tons.
Hull	$254\frac{45}{95}$
Engine-room	$70\frac{9}{95}$
Register	$184\frac{36}{96}$

Tonnage (per British Customs' Act, May 1855).	Tons.
Hull	$119\frac{76}{100}$
Allowance for engine-room ...	$33\frac{95}{100}$
Register	$85\frac{81}{100}$

One steeple-engine (has four piston-rods, on Mr. David Napier's patent principle), of 71 horse (nominal) power; diameter of cylinder, 47 inches; length of stroke, 3 feet 6 inches; diameter of air-pump, 26 inches; length of stroke, 1 foot 10 inches. Paddle-wheels — diameter, extreme, 17 feet 8 inches; effective, 17 feet 2 inches: 16 floats —6 feet 4 inches × 1 foot 6 inches: four floats in water—average draft of water, 3 feet 9 inches. One tubular boiler (vertical)—diameter, 11 feet 3 inches; depth, 12 feet 6 inches. No steam-chest. 544 composition tubes: diameter, 2 inches; depth, 4 feet: four furnaces, fired fore and aft; chimney diameter, 3 feet 2 inches × 21 feet long; consumes 12 cwt. of coals per hour; engine making 33 revolutions per minute; steam-pressure, 25 lbs. per square inch. Scantling of hull, &c.: stem and keel, 4 × ⅞ inches; frames, 3 × 3 × ⅜ inches, and 18 inches apart at midships, and 2 feet fore and aft: all the others in proportion. Is licensed, when clear of cargo, to carry 654 passengers above Dunoon and Skipness; and 349 ditto, when plying below the above places. The steerage is 18 feet 4 inches in length. Fore cabin, 13 feet 6 inches; commodious and comfortably fitted up. The cabin saloon is 31 feet long; the seats are of crimson velvet; and has a large lady's cabin: both tastefully fitted with the usual requisites, &c. The vessel is steered upon the hurricane-deck, by the ordinary steering-wheel; the connexion between the two rudders is simple and efficient. This is the first steamer that has been fitted with the double rudder to ply on the Clyde, for which purpose it is well adapted, having no necessity for putting about, as the other steamers have to do.

DESCRIPTION.

No figure-head, galleries, or bowsprit; two masts; schooner-rigged; one deck (flush); clinch-built vessel.

Port of Glasgow. Commander, Mr. Alexander Maclean.

Plying on the station between Glasgow, Greenock, Gourock, Inverkip, Largs, Fairlie, and Milport.

CLYDE AND BOMBAY LINE OF PACKETS: THE "KATE CAIRNEY."

Built by Messrs. Robert Steele and Co., shipbuilders, Greenock, 1855.

Dimensions (United States' Act).	ft.	inches.
Length from fore part of stem to after part of stern-post aloft ...	152	3
Breadth of beam	28	6
Depth of hold —	19	0
	Tons.	
Register	$775\frac{51}{95}$	
British Old or Builders' measurement.	ft.	inches.
Length of keel and fore-rake ...	150	3
Breadth of beam	28	6
	Tons.	
Register	$582\frac{27}{94}$	
Customs' New measurement (Act 1836).	ft.	tenths.
Length on deck	184	4
Breadth at two-fifths of midship depth	26	0
Depth of hold at ditto	19	0
Length of quarter-deck	37	9
Breadth of ditto, mean	21	1
Depth of ditto do.	2	9

Tonnage.	Tons.
Hull	$573\frac{69}{100}$
Quarter-deck	$25\frac{9}{100}$
Total register	$598\frac{78}{100}$
Tonnage per Customs' Act, May 1855.	Tons.
Hull	$520\frac{63}{100}$
Quarter-deck	$28\frac{41}{100}$
Total real register	$549\frac{4}{100}$
Customs' Act for foreign vessels. Tonnage.	Tons.
Hull	$563\frac{90}{100}$
Quarter-deck	$25\frac{9}{100}$
Total register	$588\frac{99}{100}$

—Showing a difference of 40 tons less by the Act which came into operation in May, over the old or builders' measurement.

These five different measurements are given, in the hope that they may be interesting to the shipowner, shipbuilder, and shipping interest generally. This vessel is a beautiful model, and will carry about 250 tons dead weight above the register tonnage; has got accommodation for a limited number of cabin-passengers, &c. Launched March 24th. Classed 13 years A 1.

DESCRIPTION.

A demi-female figure-head; no galleries; square-sterned and carvil-built vessel of timber; standing bowsprit; three masts; ship-rigged. Owners, Charles Cairnie, junior, Esq., and the Commander.

Port of Glasgow. Commander, Mr. Alexander Rodger.

CANADIAN NEW IRON CLIPPER SAILING-SHIP "CITY OF QUEBEC."

Built by Messrs. Robert Steele and Co., shipbuilders, Greenock, 1855.

Dimensions.	ft.	inches.
Length from fore part of stem to after part of stern-post aloft ...	184	4
Length of keel and fore-rake ...	175	0
Breadth of beam	30	6
Depth of hold	20	1

Tonnage.	Tons.
Builders' measurement	$780\frac{90}{94}$
American ditto	$903\frac{9}{95}$
Register per new Act	$663\frac{94}{100}$

Difference in tonnage, 117 tons by new Act over builders' measurement: will carry about 1,016 tons of cargo. The rigging is galvanised iron, and has a fine, light appearance, and strong at the same time. This vessel is built on the finest clipper lines.

DESCRIPTION.

A demi-female figure-head; no galleries; round-sterned and clinch-built vessel; flush on deck; standing bowsprit; three masts; ship-rigged. Owners, William Edmonstone, Esq., of Montreal, and others.

Port of London. Commander, Mr. John Graham.

The Durability of Iron Ships.—The iron ship *Richard Cobden*, which was built at Liverpool twelve years ago, will repay a visit from any one interested in iron ships. She has been twelve years in the East India trade, and has not had the slightest repairs done to her; has never made a drop of water, and will, to all appearance, last for an unlimited length of time. This vessel has completely set aside the old notion of A 1 for twelve years.—*Liverpool Albion*, October 1855.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 28th May, 1855.

1218. J. Leese, jun., Manchester — Obtaining colouring matter.

Dated 5th June, 1855.

1287. A. Morton and E. Hunt, Glasgow — Motive-power engines.

Dated 1st July, 1855.

1648. W. Striby, Weinham, Baden—Musical notation.

Dated 20th July, 1855.

1639. W. A. Gilbee, 4, South-street, Finsbury—New material in the manufacture of paper. (A communication.)

1645. F. Moll, Annaberg, Prussia—Materials in the manufacture of paper.

Dated 23rd July, 1855.

1663. C. Goodyear, 25, Avenue-road, St. John's-wood—Wheels for carriages, &c., where india-rubber is used.

1665. C. Goodyear, 25, Avenue-road, St. John's-wood—Bands for holding papers, &c., where india-rubber is used.

Dated 11th August, 1855.

1823. T. Hewitt, Lorn-street, Chester-road, Manchester—Machinery for pulverising and levigating.

Dated 16th August, 1855.

1865. W. Hudson, Burnley — Stop-rods or protectors in power-looms.

Dated 18th August, 1855.

1875. Robert Crawford, Beith—Ornamental weaving.

Dated 25th August, 1855.

1928. C. F. Stansbury, 67, Gracechurch-street—Shirt wrist-band. (A communication.)

1930. A. H. Hardy and J. H. Fordoff, North Bierley—Pill and ointment for scorbutic disorders.

Dated 30th August, 1855.

1956. J. Gedge, 4, Wellington-street South, Strand—Galvanising substances. (A communication.)

Dated 1st September, 1855.

1971. M. Butcher and T. H. Newey, Birmingham—Bobbins used in winding, twisting, weaving, &c.

1973. T. Dodds, 53, Wigmore street, Cavendish-square—Heating furnaces with coal or other gases.

1974. A. M. Job, 22, Halliford-street, Lower-road, Islington, and E. Tomlinson, Barn's Cray, Crayford—India-rubber leather cloth, applicable to covering roofs, &c.

1975. F. C. Calvert, Manchester—Heating, puddling, and refining iron slags.

1977. T. S. Prideaux, Willow-house, Hampstead—Marine steam-boiler furnaces and flues.

1979. A. V. Newton, 66, Chancery-lane—Gas for illumination. (A communication.)

Dated 3rd September, 1855.

1981. W. M'Liesh, Belfast—Boiler furnaces, and prevention of smoke.

1982. A. Heaven, Manchester—Embroidering fabrics.

1983. G. T. Holden and R. Nicholas, Brook-street, St. Paul's, Birmingham—Roasting-jack.

1985. J. T. Chance and H. Adcock, Birmingham—Casting articles of slags produced by the smelting of iron and other ores.

1987. E. Sy, Paris—Motive power.

1989. H. E. Flynn, Retreat, Ranelagh, Dublin—Prevention of railway accidents.

1991. J. Humby, 4", Little Britain—Machine for cutting vegetables.

1993. A. H. Golding, Maidstone—Apparatus for blocking and lasting leather.

Dated 4th September, 1855.

1995. C. Clark and J. Clark, Street, Glastonbury—Boots and shoes.

1997. J. T. Taylor, Glasgow—Coating or plating metallic surfaces.

1999. T. T. Coniam, Chagford, Devon—Tiles for roofing.

2001. C. G. Mueller, South Carolina, U.S.—Locks for doors.

2003. W. A. Gilbee, 4 South-street, Finsbury—Manufacture of glass. (A communication.)

2005. W. Southwell, Philadelphia, U. S.—Machinery for grinding or polishing saws and other articles.

Dated 5th September, 1855.

2007. G. H. Ingall, Bartholomew-lane—Self-acting signal-posts and apparatus.

2008. W. Craymer, Bristol—Propelling vessels.

2009. G. Collier, Halifax—Carpets.

2010. A. Palmieri and J. B. Ferrari, 39, Rue de l'Echiquier, Paris—A new system of construction of ships or vessels. (A communication.)

2011. J. H. Glassford, Glasgow—Printing textile fabrics.

2012. G. Peacock, Gracechurch-street—Shipbuilding.

2013. J. G. Martien, Newark, New Jersey, U. S.—Roasting, calcining, oxidising, and subliming metallic and mineral substances.

2014. I. Nettleship, Derby—Spindle for spinning silk, &c.

Dated 6th September, 1855.

2015. S. A. Goddard, Birmingham—Preventing the fouling of fire-arms, and cleaning the same.

2016. T. Schwartz, New York, U.S.—Heating or cooling aëriform and liquid bodies.

2017. C. P. Aston, Cross-street, London—Breech-loading arms.

2020. W. A. Gilbee, 4, South-street, Finsbury—Purification and clarification of oils. (A communication.)

Dated 7th September, 1855.

2021. G. Lowry, Manchester—Machinery for heckling flax, &c.

2022. S. Hand, Glinton Iron Works, Glinton—Combined cake-crushing, oat-bruising, and bean-splitting mill.

2023. F. Garand, Paris—Machinery for cutting veneers.

2024. R. A. Brooman, 166, Fleet-street—Casting mortars, cannon, &c. (A communication.)

2025. N. Templeton and D. Miller, Glasgow—Manufacture of figured fabrics.

2026. J. Stewart, Preston — Steam-boilers for the more effectual consumption of smoke.

2027. J. M'Intyre, Jarrow-upon-Tyne, Durham—Caulking decks, ceilings, and floors.

2028. L. Dameron, Paris—Construction of carriages.

2029. L. P. Reynaud, Paris—Endless stair crane.

Dated 8th September, 1855.

2030. H. Hart, 5, Waterloo-crescent, Dover—Lubricating and burning oils. (A communication.)

2031. E. H. Rascoll, Catherine-street, Strand—Fastening for wearing apparel as a substitute for buttons. (A communication.)

2033. J. H. Tuck, Pall-mall — Dredging and excavating machinery. (A communication.)

2034. H. Boucherie, Bordeaux—Impregnating woods with chemical materials, &c.

2035. T. H. and W. Hemsley, Melbourne, Derbyshire—Fabrics in warp and twist-lace machines.

2036. A. H. Durant, Tong-castle, Salop—Raising and lowering weights, and saving persons, &c., from fire.

2037. J. Bird, Seymour-street West — Manufacture of biscuits.

2038. A. H. A. Durant, Tong-castle, Salop—Apparatus for ascertaining the number of, and distance travelled by, passengers in public carriages.

2039. P. A. Balestrini, Brescia, Lombardy — Insulating wires for electric telegraphs.

2040. A. H. A. Durant, Tong-castle, Salop — Sweeping chimneys.

2041. A. Robertson, Nether Holchouse, Neilston, Renfrew—Treatment, cleansing, and finishing of textile fabrics.

2042. H. Webster, Dalby-terrace, City-road — Construction of chronometers, clocks, watches, &c.

2043. E. Grenet, jun., Paris—Electro-magnetic apparatus for motive power.

2044. J. Panet, Echenoz-la-Meline, France — Hydraulic system for propelling on railways, or obtaining motive power and distributing water.

2045. T. Allan, Adelphi-terrace—Correcting deviation of the compass-needle.

Dated 10th September, 1855.

2046. C. Hewett, 8, King's-road, Pentonville—Baking ovens.

2047. E. Sharpe, Swadlincote, Derby—Water-closet pans.

2048. J. Rhodes and J. Johnson, Manchester — Steam-engines.

2049. A. E. Bellford, 32, Essex-street, Strand — Paddle-wheels. (A communication.)

2050. A. E. L. Bellford, 32, Essex-street, Strand—Governor for steam-engines. (A communication.)

2051. T. Craven, Nelson-street, Goodman's-fields—Furnace-bars.

Dated 11th September, 1855.

2052. J. Gimson, Welford-road, Leicester—Feed apparatus for steam-boilers.

2053. H. Bull, Staines—Permanent way.

2054. G. S. Hinchliff, Piccadilly—Paperhangings. (A communication.)

2056. F. H. Lebaigue, Little Titchfield-street—Chocolate.

2057. M. Curtis and J. Wain, Manchester—Spinning machinery.

2058. J. C. G. Kennedy, St. James's-street, Piccadilly—Electric telegraph apparatus, &c. (A communication.)

2059. E. C. Z. Bouchard, Paris—Gas.

Dated 12th September, 1855.

2060. J. Higgin, Manchester—Treating madder or preparations of madder.

2061. J. Macintosh, Great Ormond-street—Springs.

2063. F. G. Spilsbury, Chaud-fontaine, Belgium, and F. W. Emerson, Stable Hobba, near Penzance—Paints and pigments.

2064. J. G. Roger, Trinity-street, Cardiff—Ships' signal lanterns.

Dated 13th September, 1855.

2065. B. Barber, Tring, J. Butterfield, and T. Austin, Great Berkhampstead—Mangles.

2066. J. Macintosh, Great Ormond-street — Metallic and other pens.

2067. P. B. de Lucenay, Paris—Batteries of guns and pistols.

2068. R. B. Cousens, 50, Halliford-street, Islington — Machinery for making casks.

2069. J. Blissett, 322, High Holborn—Revolving-chamber fire-arms.

2070. J. H. Tuck, Pall-mall — Apparatus for submarine operations. (A communication.)

2071. A. Longbottom, 41, Moorgate-street—Gas.

Dated 14th September, 1855.

2072. J. Hartmann, Mulhouse, France—Colours for printing stuffs and textile fabrics.

2073. J. P. Garbai, Paris—Tooth-powder.

2074. W. Church, Birmingham—Mounting ordnance and other fire-arms.

2075. T. Gomme, jun., and C. E. A. Beaugrand, Paris—Metal-working machinery.

2076. V. Scully and B. J. Heyward, Dublin—Bottles, ink-stands, &c., and in caps for closing the same.

2077. G. Dewdney, Fenchurch-street — Chest and throat protector.

2078. F. Stocken, 5, Halkin-street, Belgrave-square—Carriage-springs.

2079. W. F. Thomas, St. Martin's-le-Grand— Sewing-machines.

Dated 15th September, 1855.

2080. W. Oxley, Manchester—Machinery for washing.

2082. J. G. Martien, Newark, New Jersey, U. S. — Manufacture of iron and steel.

2084. V. Scully and B. J. Heywood, Dublin—Manufacture of articles subject to corrosion.

2086. W. Sangster, Cheapside—Stays and corsets.

2088. D. Zenner, Newcastle-upon-Tyne — Washing and separating pulverised ores and matters. (A communication.)

2090. A. Ford, St. James's, Middlesex—Solutions of caoutchouc, gutta percha, &c.

Dated 17th September, 1855.

2092. J. Lewtas, Manchester—Apparatus for holding and letting go cords, chains, or bands.

2094. T. Forsyth, Manchester—Treatment of scrap-iron.

2096. W. H. Smith, Birmingham—Bolts, latches, and locks.

2098. J. T. Caird, Greenock—Steam-engines.

2102. R. A. Brooman, 166, Fleet-street — Raw silk. (A communication.)

Dated 18th September, 1855.

2106. R. A. Brooman, 166, Fleet-street—Knitting machinery. (A communication.)

2108. F. H. Smith, Ludgate-hill—Break for carriages with poles.

2110. W. Warren, Regent-place, Birmingham—Vices.

Dated 19th September, 1855.

2112. L. Cornides, 4, Trafalgar-square, Charing-cross — Impressions of prints or drawings, and in transferring, printing, and colouring, or ornamenting the same on glass or other surfaces.

2114. S. Coulson, Sheffield—Ornamented metal tea-pots, &c.

2116. R. A. Brooman, 166, Fleet-street—Preserving animal and vegetable substances. (A communication.)

Dated 20th September, 1855.

2118. H. Deacon, Widnes Dock, near Warrington—Solutions of carbonate of ammonia and caustic ammonia.

2120. J. Palmer, Stockton-on-Tees—Reaping-machines.

Dated 21st September, 1855.

2122. J. Dale, Manchester—Appropriating waste products arising in chemical manufactures.

2124. U. J. Brasseur, Paris—Machinery for winding weft. (A communication.)

Dated 22nd September, 1855.

2126. J. Eaton, Charing-cross—Shuttles and cop-tubes.

Dated 24th September, 1855.

2128. H. Mottet, jun., Verviers—Scouring woollen goods during the action of fulling or otherwise.

2130. J. M. Marchinton, Sheffield—Vices.

2132. C. Manby, 25, Great George-street, Westminster, and W. Piper, Palace-road, Stangate — Machinery for cutting stone. (A communication.)

2136. G. Simmonds, Bennett-street, Stamford-street—Bedsteads.

Dated 25th September, 1855.

2138. W. and J. Wright, Stamford—Crushing grain.

2140. C. F. Whitworth, Halifax—Railway signals.

2142. F. R. Ensor, Nottingham—Lace-machines.

Dated 26th September, 1855.

2144. G. Huguenin, Greek-street—Watches.

2146. J. Norbury, Salford—Hydraulic presses.

2148. J. Nasmyth, St. Germain-en-Laye, France—Motive power.

Dated 27th September, 1855.

2152. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Forging iron. (A communication.)

2154. M. A. Atkinson, Wandsworth, and B. Ridge, M.D., Putney—Steam-boilers, &c.

2156. J. Newman, Birmingham—Railway wheels.

2158. J. Nottidge, Chemical Works, Walworth—Manure.

Dated 28th September, 1855.

2160. J. H. B. Thwaites, Bristol—Teeth.

2162. J. T. Pitman, 67, Gracechurch-street—Screw-wrench. (A communication.)

2166. R. Robey and G. L. Scott, Lincoln—Boilers.

2168. J. Good, Lincoln— Straw-shakers of threshing-machines.

Dated 29th September, 1855.

2172. W. B. Herapath, M.D., Bristol—Surgical instruments.

Dated 1st October, 1855.

2176. J. Gedge, 4, Wellington-street South—Braid. (A communication.)

2178. J. Gedge, 4, Wellington-street South—Preservation of grain. (A communication.)

2182. G. Wilkinson, Poplar—Steering apparatus.

2186. J. F. V. Augier, Paris—Extracting aroma from plants and flowers.

2188. T. Dickens, Middleton—Doubling and throwing silk, &c.

2190. G. C. Hope, Hastings—Producing designs upon textile fabrics for the purposes of needlework.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2062. J. Partridge and J. Kirkham, West Bromwich—Malt-crushers.—12th September, 1855.

2091. J. Gray M.D., Nos. 4 and 5, Princes-street, Dublin—Water-closet arrangemeut.—17th September, 1855.

2100. A. E. L. Bellford, 32, Essex-street, Strand—Fountain lamps. (A communication.)—17th September, 1855.

2150. T. Deakin, Hazelwell Mills, near King's Norton, Worcester—Machinery for manufacturing bayonets, matchets, and swords.—26th September, 1855.

2164. T. Clegg, Massachusetts, U. S.—Loom harness.—28th September, 1855.

2166. T. Barrows, Massachusetts, U. S.—Treatment of wool preparatory to its being carded, spun, or woven.—28th September, 1855.

2174. Captain W. N. Martin, Newman-street, Oxford-street — Folding and portable crates, boxes, baskets, packing-cases, and huts.—29th September, 1855.

DESIGNS FOR ARTICLES OF UTILITY.

1855.

Sept. 20, 3760. E. R. and F. Turner, St. Peter's, Ipswich, "Improved mill-frame."

„ 25, 3761. Ravel Linneker, Norton Woodseats, "Linneker's smoke-consuming furnace."

„ 27, 3762. Woog Javal, 13, Broad-street-buildings, "Focus regulator."

Oct. 1, 3763. James Burnett Huden, Warminster, "The Crimean stove."

„ 5, 3764. Wright, Underwood, and Burt, 48, Paternoster-row, and 18, Thomas-street, Bristol, "Hermis-carpon, or wrist-supporter."

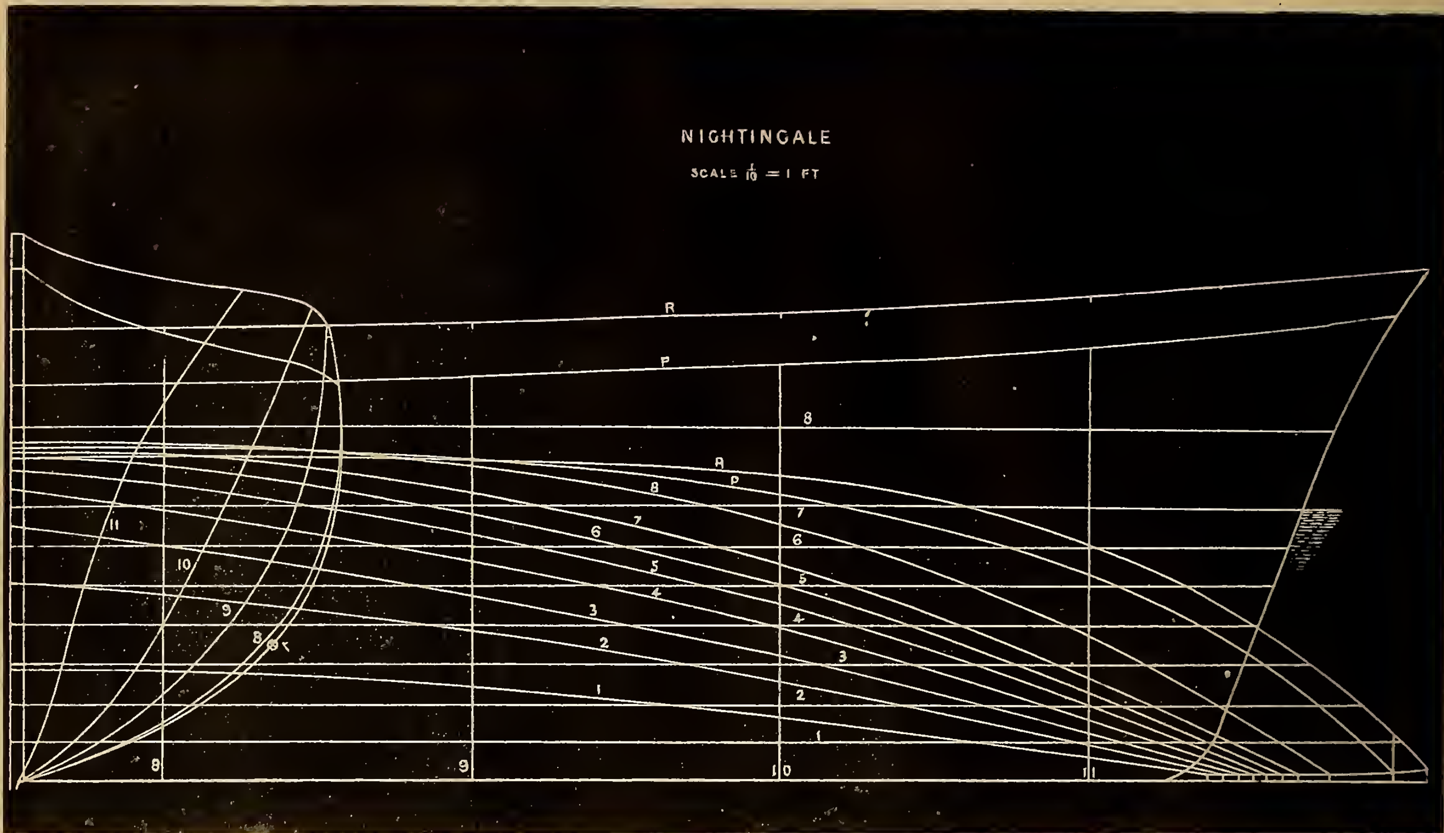
„ 11, 3765. Joseph Stoker, 57, Old-street, "Improved pack-saddle."

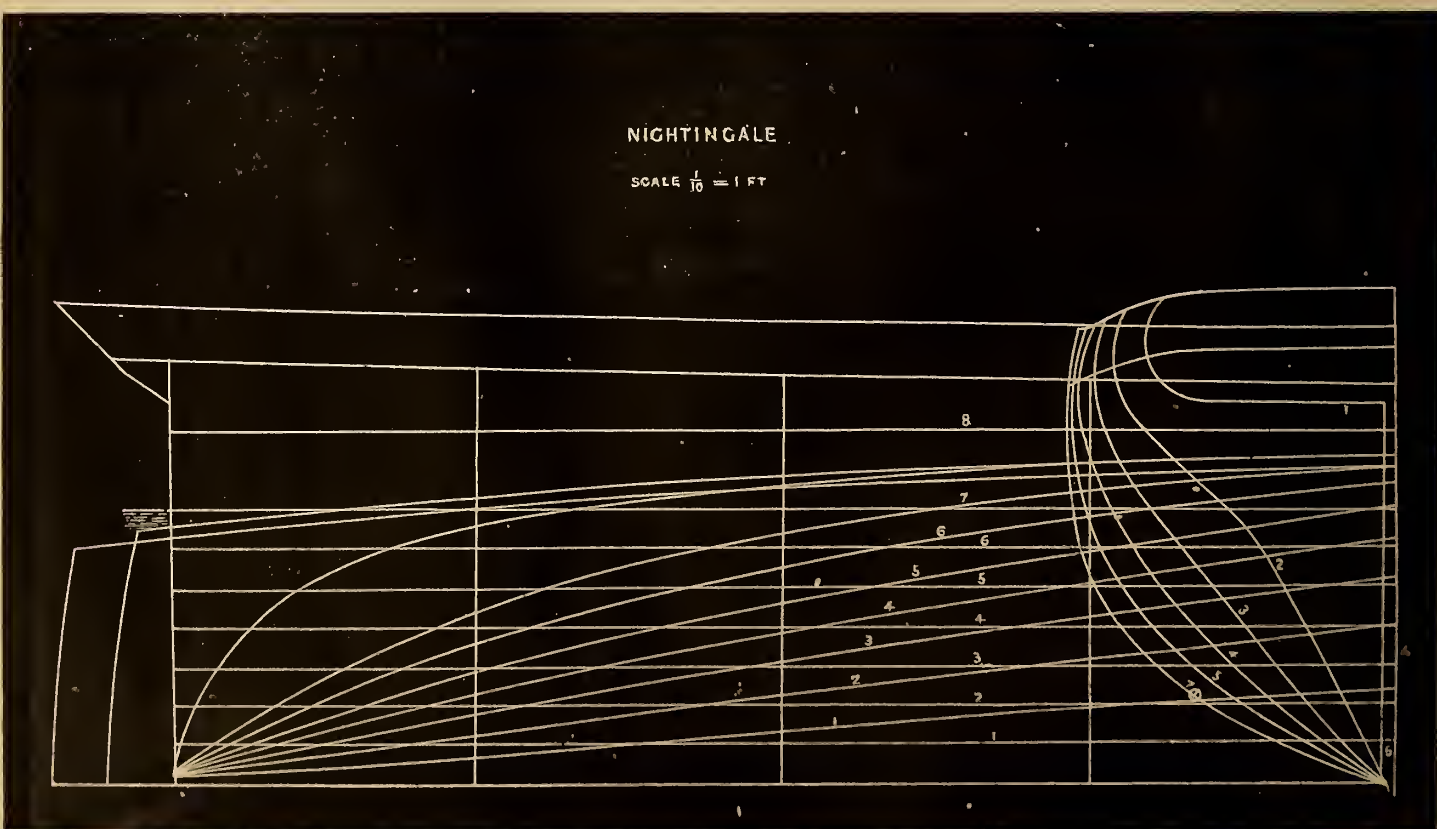
„ 12, 3766. Winnal Thomas Dalton and Son, Narrow-street, Ratcliff, "A socket-bush for blocks."

„ 13, 3767. Leake and Dodds, 35, Wigmore-street, "Paragon portmanteau."

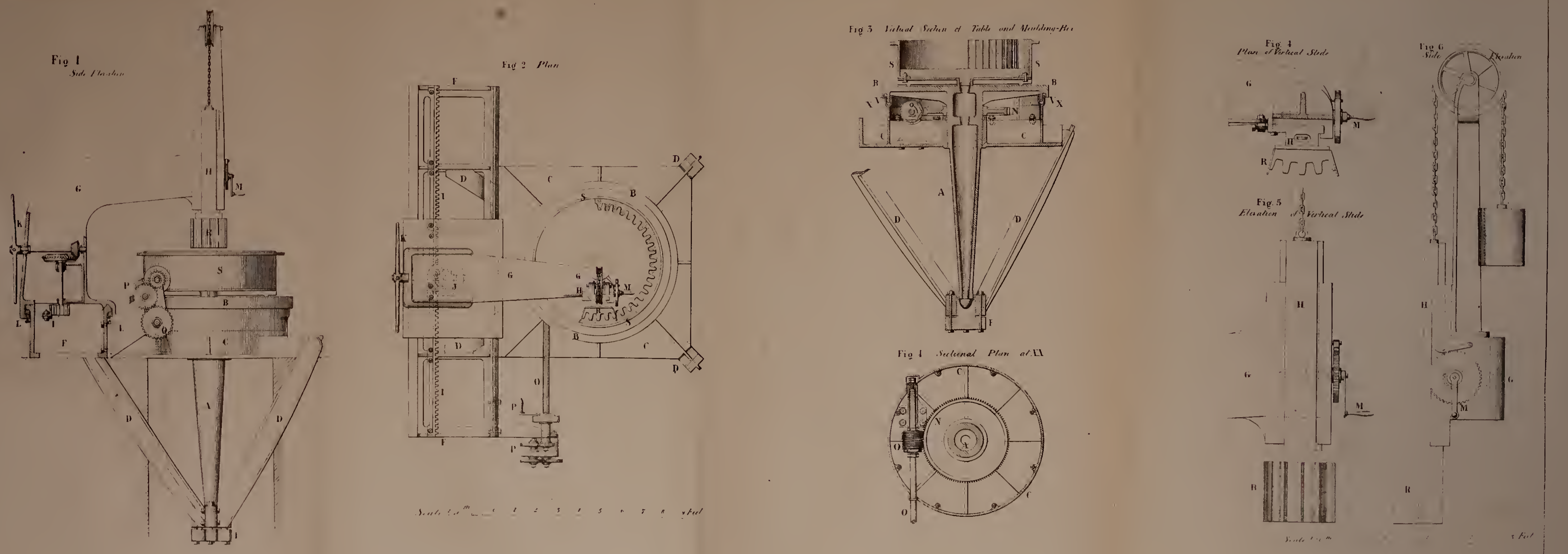
„ 13, 3768. Crichley, Wright, and Co., Burton-Weir, Sheffield, "Lever counterpoise."

„ 17, 3769. William Blackford, 19, John's-terrace, Camberwell-gate, "Self-adjusting window-frame for carriages."

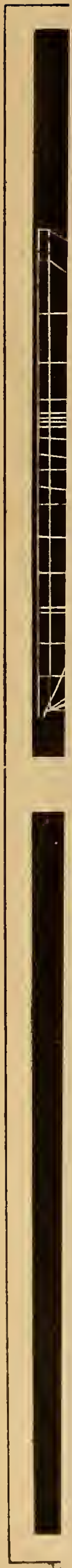

NIGHTINGALE
SCALE 1/10 = 1 FT


NIGHTINGALE
SCALE 1/10 = 1 FT

P. R. JACKSON'S, WHEEL MOULDING MACHINE.

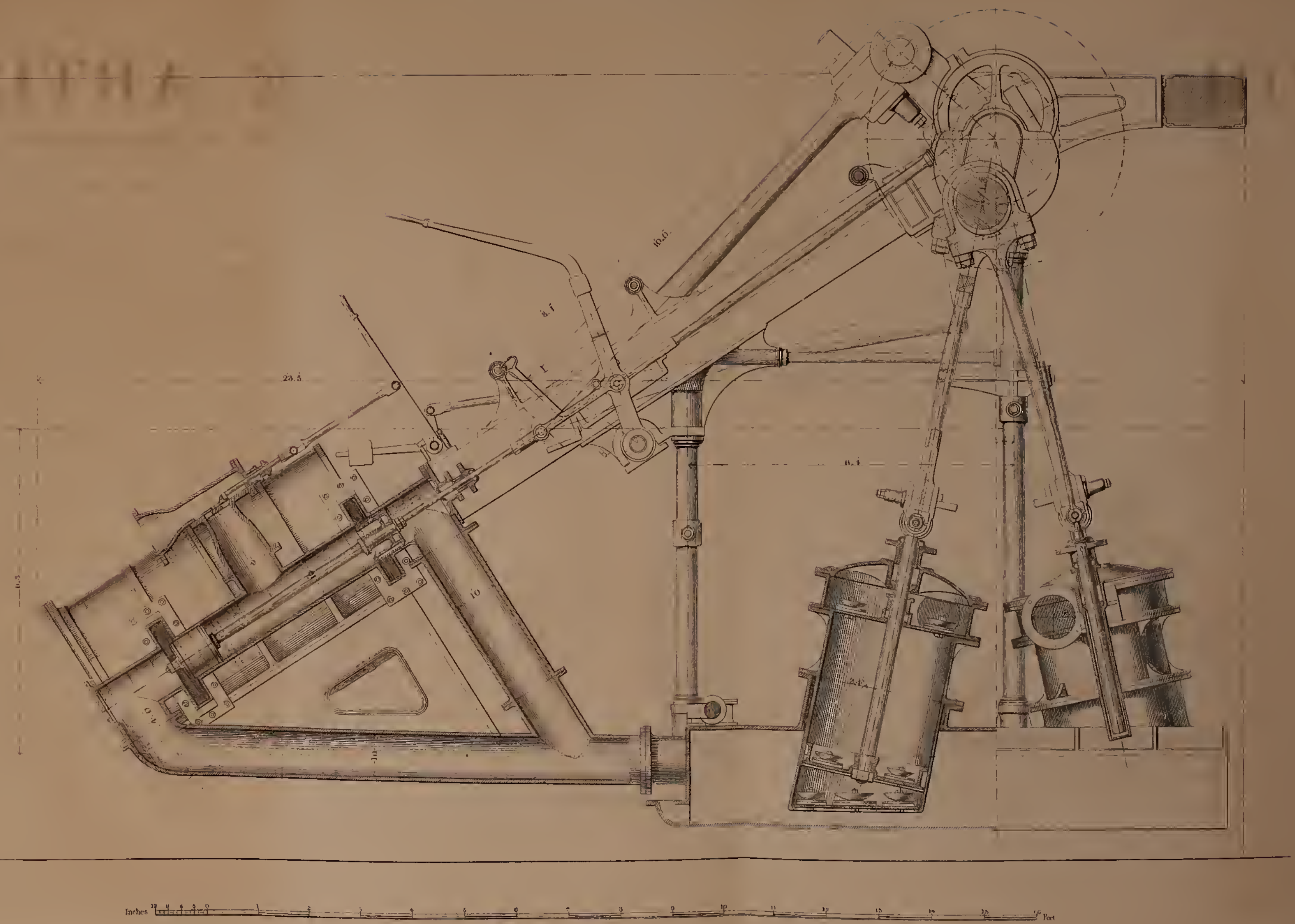


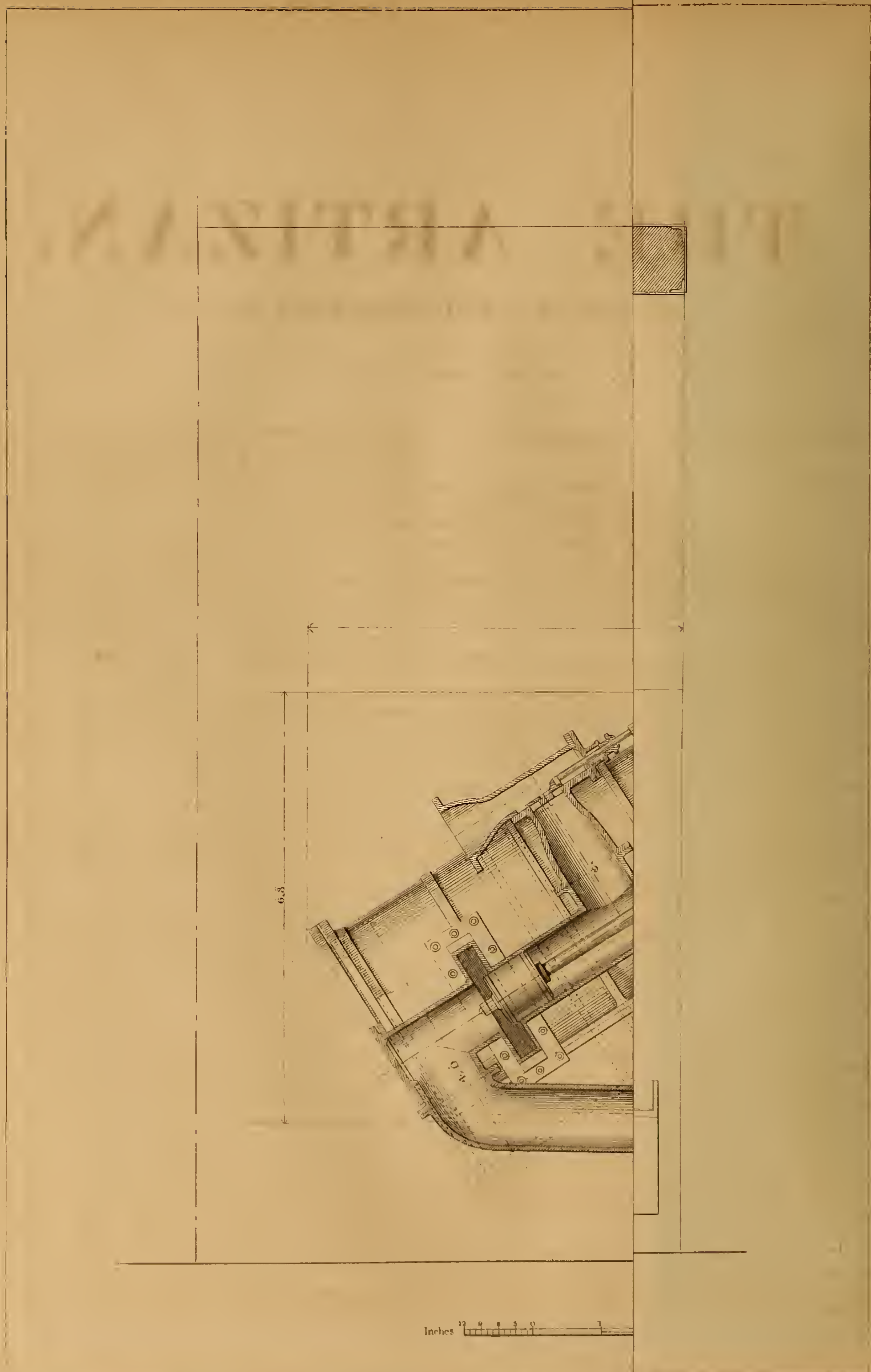
W Smith C E direx



ENGINES OF THE BATAVIER

NETHERLANDS STEAM-BOAT COMPANY.





W. Smith C. E. Dirext

C. Chabel, Engraver

THE ARTIZAN.

No. CLV.—Vol. XIII.—DECEMBER 1st, 1855.

THE PARIS UNIVERSAL EXPOSITION, 1855.

Instruments of Precision.

This term, which may not be generally understood by English readers, has been used by the French, during the last few years, to comprehend all that important collection of apparatus used for measuring and weighing. These instruments of precision comprise all machines and apparatus for measuring lengths and capacities; all machines, as clocks, watches, and chronometers, for measuring time; all weighing machinery, all dividing engines, and a great variety of optical and meteorological apparatus serving to determine the forms and other properties of matter.

Amongst the balances of precision, there are some for which the exhibitors lay claim to an almost incredible accuracy.

Thus, a balance exhibited by Lecomte, of Paris, (No. 1,674 in the Catalogue,) is calculated to weigh up to 300 grammes with an error of only half a milligramme. This, converted into English measure, would be about 10 ounces avoirdupois, with an error of only $\frac{1}{600000}$th part. The price of this balance, as marked, is 300 francs, or £12 sterling.

This accuracy is far exceeded, however, by some others: for instance, there are several calculated to weigh 250 grammes, with an error of $\frac{1}{4}$ of a milligramme. This, in English weight, is about 8 ounces avoirdupois, with a sensibility of 1-millionth part. The price of this balance is about 250 francs, or £10 sterling.

The larger balance of Messrs. Collot Brothers, of Paris, (No. 1,661 in the Catalogue,) pretends to far greater accuracy, and is represented as capable of weighing 2 kilogrammes, or more than 4 lbs. avoirdupois, with a maximum error of $\frac{1}{20}$th of a milligramme, or $\frac{1}{40}$-millionth part of the whole. Price 1,200 francs, or about £48 sterling.

The following are notices of some other French balances:—

One to weigh 2 kilogrammes, with a sensibility of $\frac{1}{10}$th of a milligramme = 4 lbs. English, with a sensibility of $\frac{1}{20000000}$th part.

One to weigh 40 kilogrammes, with a sensibility of 5 milligrammes = 88 lbs. English, with a sensibility of $\frac{1}{8000000}$, or $\frac{1}{8}$-millionth part.

The British balances of precision do not pretend to such a high degree of accuracy. For instance, No. 408, Great Britain, exhibited by Oertling, of 12, Store-street, London, for chemical analysis, is adapted to carry 1,000 grains in each scale, and, when loaded with this weight, will turn with $\frac{1}{1000}$th of a grain. This is a sensibility of 1-millionth. The knife-edges as well as the planes in this balance are of agate. From the centre or axis of the beam is suspended a fine steel pointer, which denotes the equilibrium of the balance on a short graduated ivory scale. Most of the French balances of precision are provided with a similar contrivance.

In the department of Clocks and Watches, we find a host of names distinguished not less for the striking improvements they have made in this branch of mechanics, than for the prizes and honours which have been conferred upon them ever since the French people first began to reward and encourage industry and talent by means of national exhibitions. Conspicuous amongst these names are those of Berthoud, Bréguet, Garnier, Jafy, Robert, and Wagner, all of whom were rewarded by numerous former prizes and medals, and some of whom have even been decorated as members of the Legion of Honour, for their scientific discoveries and improvements.

There are nearly 200 French exhibitors of clock-work, comprising every variety of timepiece, from the smallest pocket-watch to the great clocks employed in churches and public buildings. Many of the clocks are adapted to astronomical purposes; many are ornamented with the most exquisite gilding and other ornamental work; while, in others, the beauty and ingenuity of the contrivances to compensate for and guard against every possible source of error are most to be admired.

The luxury, wealth, and prosperity of the French nation are nowhere exhibited in a more remarkable manner than in the extravagant prices demanded for many of these clocks. In many cases the selling prices are marked on the articles; and it is no uncommon sight to observe 8,000 francs, and even much larger sums, affixed to these costly specimens of skill and taste.

From Switzerland, also, there are more than 70 exhibitors of clocks and watches, amongst whom are many of the celebrated makers of Geneva watches. From other countries the exhibitors are comparatively few, there being less than twenty from Great Britain, and fewer still from most other countries.

Some very ingenious apparatus are exhibited by M. Robert, of Paris, for teaching astronomy, in the shape of orreries and other contrivances.

A machine for dividing, by L. G. Pureaux, of Paris, is worthy of attention. A vertical brass bar carries a short spirit-level, which moves horizontally up and down the bar. The intersection of the cross-wire with various points on the object to be divided gives the division with extreme accuracy. The clamp of the level is furnished with a vernier and micrometer screw; the delicacy of the apparatus being such, that divisions can be made as small as the 200th part of a millimetre = the 200,000th part of a metre, or the 5,000th part of an inch.

The same exhibitor has also machines for measuring the tenacity and elasticity of threads, cordage, cloth, and all kinds of woven fabrics. The extension is produced by the motion of a screw, and its exact amount at the moment of breaking is indicated on a dial, the hand of which is acted on in proportion to the extension. This machine is said to be extensively employed in public departments for testing the strength and value of materials supplied to them under contract and otherwise.

The drawing instruments of the Swiss and French makers are exhibited in abundance. They are exquisitely finished, and are somewhat cheaper in price than those of the best English makers.

Astronomical Apparatus.

There are more than 100 French exhibitors of telescopes, transit instruments, and other astronomical apparatus. The French have long been celebrated also for their instruments for measuring angles, to which they have devoted much attention in consequence of their metrical system being founded on the exact measurement of an arc of the meridian. They allege that the repeating circle of Borda was first constructed by M. Lenoir, a French mechanician, in 1819. Among the exhibitors of astronomical instruments are the names of many celebrated men, some of whom have been rewarded by gold medals and decorations at many former exhibitions.

Some object-glasses of very large size are exhibited from Munich, in Bavaria, which has long been celebrated for this manufacture.

The gallery of design surrounding the panorama contains a model of the moveable cupola of the Observatory of Paris, constructed in 1845 to receive the great equatorial mounted telescope for following the motion of the stars. A part of the cupola is open; and as it turns round with the telescope, the view from the latter is always clear. The diameter of the cupola is 40 feet, its height 30 feet; weight of metal in the roof, 92,500 lbs.

There are good transit instruments exhibited by Stark, of Vienna, and by Cooke, of York; but there are several attempts to popularise the subject of astronomy, by public bodies and individuals in Great Britain, which throw all other efforts of this kind into the shade. Among the most successful and instructive objects in the whole Exposition are the admirable models of the full size from Greenwich Observatory, and those from the celebrated private observatories of Lord Wrottesley, in Staffordshire, and Lord Rosse, in Ireland.

The models sent by Professor Airey, from Greenwich, relate to the Great Transit Circle at the Royal Observatory, the model of which is complete, except the ladders.

A full description of this Transit Circle was published in the Appendix to the Greenwich Observations for 1852. The telescope is 10 feet long, and is fixed with its axis exactly in the meridian of Greenwich, the eye-piece being the north end and the object-glass the southern extremity of the telescope. The telescope is formed by a double conical tube, and a cubical central piece, carrying on its eastern side a clamping circle, and on its western side a graduated circle. The divisions of the graduated circle are viewed by means of eleven microscopes, the tubes of which are inserted in perforations of the western pier. In order to examine the wires of the great telescope, and to determine their perfect adjustment, four collimating telescopes, each about 6 feet long, are fixed, one at each extremity of the great telescope, and one on each side. These collimating telescopes are permanently fixed on stone columns, at an invariable height, and with their axes exactly on a level with the true axis of the great telescope. It will be easily perceived how the collimating telescopes, placed at either end of the great telescope, will serve for adjustment, as an analogous process is sometimes used for adjusting the common spirit-level; but it is not so easy to perceive how the collimators placed at the side can be used for adjustment of the wires. In order to comprehend this, it must be explained that the axis of the great telescope is hollow, as well as the main tube, and, by a most ingenious system of lighting, the observer is enabled by the side collimators to see into the interior of the great telescope. Thus, there are four points—namely, all the cardinal points of the compass—from which the diaphragm of the great telescope can be observed; and if the least variation in its position be noted—that is, if it be the least out of the true axis—means are immediately taken to adjust and set it right, by the aid of apparatus provided for the purpose.

The graduated circle, on which the angles of elevation are read through the microscopes in the western pier, as already explained, is about 6 feet in diameter. The axis of the great telescope is supported in iron Y's, which are castings of remarkable hardness produced by chilling. Besides the full-sized model of the great telescope and its accessories, there is also a half-sized model, showing the method of illuminating the wires inside the great telescope. This is effected by an opening in the western pier, and a large condensing glass, about 8 inches diameter, placed in the opening. The glass concentrates the light, and illuminates the inside of the telescope in the same manner as the condenser in the achromatic microscope.

The optical part of the instrument was constructed by Troughton and Simms, of London; and the iron-work and more massive parts of the instrument, by Ransome and May, of Ipswich. The object-glass was purchased from Mr. Simms in 1848; and the instrument was erected and first used in 1851.

No. 1929 in the French department, exhibited by M. Secretan, of Paris, is a large telescope mounted to follow the motion of the stars for latitude 48° 50′. This telescope is 12 feet 4 inches in length, and the object-glass is 9 inches diameter.

The transit instrument by Stark, of Vienna, has a telescope of 4 feet focal length, with a hollow transverse axis, fixed telescopes, and an illuminating lamp for collimation. Two 18-inch circles, with verniers, are attached for reading the observations; and there is a contrivance for adjusting the axis to perfect horizontality. The price of this instrument, which is beautifully finished, is 5,800 francs, or £230.

Of smaller astronomical instruments there is a copious collection from Richard Willats, of Ironmonger-lane, London, who displays also levels, compasses, and microscopes.

There is an interesting model of Lord Rosse's telescope at Parsonstown. This immense instrument has an aperture of 6 feet, and a focal length of 53 feet.

Several reflecting circles and other apparatus are exhibited from Dr. Piazzi Smith, Astronomer Royal for Scotland.

The model and description of Lord Wrottesley's observatory, in Staffordshire, about half-way between Wolverhampton and Shiffnal, are also worthy of attention. Lord Wrottesley has here an achromatic telescope, 10 feet 9 inches in focal length, with an object-glass of $7\frac{3}{4}$ inches clear aperture, purchased from Mr. Beaumont, of Finningley. The Wrottesley observatory, which was erected in 1842, and in which some very valuable observations have since been made, contains also a 5-foot transit instrument. The telescope is driven by clock-work, and is equatorially mounted, after the English fashion.

Philosophical Apparatus.

M. Chevalier, the celebrated engineer-optician in the Palais Royal, Paris, exhibits a good collection, among which are microscopes, stereoscopes, and apparatus for diffraction, besides theodolites and levelling instruments.

Several good dynamometers and pressure indicators are exhibited by P. Clair, of Paris. The dynamometer has a spring, to which two pencils are attached; and these mark on a slip of paper, which passes round their rollers, moved by clock-work. The pressure indicator records the varying amount of pressure on cylinders covered with paper, and also moved by clock-work.

Bianchi, of Paris, exhibits a pneumatic machine of improved construction, anemometers, apparatus for polarisation of light, &c. He has also an instrument for measuring the volume of gunpowder by displacement of mercury in a tube. This instrument is used by the Minister of War for trying the specific gravity of grains of gunpowder.

Meteorological Apparatus.

It is astonishing what an amount of ignorance prevails with respect to the commonest meteorological phenomena, and how scanty and insufficient are the facts and data relating to winds, rain-fall, and evaporation, whenever exact quantities are sought for practical and economic purposes.

These meteorological facts are of the highest importance in the establishment of water-works for towns, and in many other cases which fall within the province of the engineer; and hence the great value to be attached to the observations which have now been made for some years at Kew, at the instance and under the sanction of the British Association for the Advancement of Science. Among the meteorological apparatus from Kew is a simple form of rain-gauge, consisting of an open inverted case of copper, about 12 inches diameter, provided with a graduated glass measure. There is Robinson's portable anemometer, or wind-measurer, an instrument with four hemispherical cups, fixed at the extremity of four horizontal arms, each about 8 inches long from the centre. The cups are each about $2\frac{1}{2}$ inches diameter, and their revolution works a system of wheels.

There is also an evaporation gauge, invented by Francis Ronalds, Esq. There are standard barometers and thermometers, magnetometers, portable vibration apparatus, declinometers, standard compasses, and various other instruments, by celebrated makers.

There is also a collection of meteorological instruments exhibited by Mr. Glaisher, of Lewisham, for the Meteorological Society; and an ingenious anemometer by Dr. Piazzi Smith, Astronomer Royal of Scotland, for recording the pressure and direction of wind at sea.

There is a very superior standard barometer exhibited, which has been constructed for the Meteorological Observatory of Lisbon, to measure the pressure of the atmosphere to $\frac{1}{100}$th of a millimetre, or about the $\frac{3}{1000}$th part of an inch. The observation is effected by reading microscopes attached to clamps, which embrace and move on a triangular bar. The rough adjustment is obtained by moving the clamp by hand, and a further fine adjustment is made by means of a delicate micrometer screw. The height of the mercury is read off both at the base and the top of an exhausted bent tube.

BRIEF NOTES OF CONTRIVANCES EXHIBITED IN THE FRENCH EXPOSITION, INTENDED AS SUGGESTIONS TO THE ARTIZAN AND MECHANIC.

A Boat adapted for travelling, both on a railway and in water, as practised on the Rhine between Hombert and Ruhrort.—Where vehicles of this kind are used, the goods are transferred from one mode of carriage to another—namely, from land-carriage to water-carriage, and *vice versâ*—without breaking bulk, or in any way interfering with the cargo.

Model of a Fishing Vessel, with an open cylinder in the centre, through which passes a net suspended like a cone from near the top of the mast.—The diameter of the cylinder is about half the breadth of the vessel, and the top of it is as high as the deck or sides. Under the bottom of the vessel is fixed a large ring of galvanised iron, the diameter of which is nearly three times the breadth of the vessel, and the centre of which coincides with the centre of the cylinder. The weighted circumference of the net, when not in use, is drawn tight by cords, till it is in contact with the ring; and when the cords, which work through pulleys, are loosed, the net descends, and in collapsing encloses the fish which are so unfortunate as to fall within its ample precincts.

Model of a Screw Steamer intended to navigate under water, with a chamber for men to work in, as in a diving-bell.—The working chamber is in the forward part of the vessel, and is divided into an upper and lower part, by means of a horizontal partition. A large telescope, with the eye-glass and object-glass both fixed at right angles to the tube, is so placed and capable of such adjustment, that the men employed in the boat can see into the water outside. The principal value of this kind of boat, which is adapted to navigate either in the ordinary way on the surface, or to sink down and navigate at any required depth below the surface, would appear to be founded on its use in time of war. It seems perfectly well adapted to pass under water, and blow up an enemy's fleet or destroy fortifications, &c. We see no provision for supplying fresh air to the chambers in which the men work; but these are described as being of very large capacity, and capable of containing no less than 3,000 men.

Improvement in Conventional Signs for Maps.

Great difficulty and inconvenience are often experienced in attempting to communicate a large amount of statistical or scientific detail on ordinary maps. Ordinary colouring and writing used for this purpose are soon exhausted, and the surface of the map soon becomes confused and intricate when crowded by too much detail. A map on which all the geographical and topographical features are faithfully shown by black lines and shading, can afterwards be made geologically valuable by having the formations coloured and shaded: but suppose, in addition to this, it be required to convey statistical information, as to coal-fields, iron-works, or other manufactures, it is almost impossible to do this without having recourse to distinct maps. The large diagram maps prepared for the walls of Parliamentary Committee-rooms afford specimens of the want of skill and ingenuity which prevails in the mode of conveying information of this kind. Nothing can be worse or less tastefully contrived than some of these maps for conveying the information intended. True, this is not to be wondered at, when we consider that these maps are seldom prepared in the engineer's office, under the skilful eye of those having the capacity and the means to convey information, but are often entrusted to a set of ignorant, dissolute, half-drunken draughtsmen, employed in the same manner and at the same rate of pay as their miserable copying clerks, by some of the law-stationers and other tradesmen in Westminster. No wonder that the maps which emanate from such studios are unmeaning and senseless daubs, conveying little information and deserving no credit. One of the tradesmen who frequently disfigure the walls of committee-rooms by maps of this kind actually advertises the preparation of what he calls *mural maps*, which probably refers to sign-painting of this description. The abuse of words often excites a smile, and this appears to be one derived from a vocabulary of singular meagreness and affectation.

The improvement in conventional signs to which we are desirous of drawing attention consists in the use of raised colours above the surface of the map. In some of the maps from Austria and Russia, pins with coloured heads are used for this purpose, and being stuck into the map, denote the site of works or manufactories. Railways, canals, roads, &c., may either be shown by lines on the surface, or by cords of different colours projecting above the surface; while lines of electric and magnetic telegraph are shown by their wires, carried on pins, which support them.

The application of the system to maps will be best shown by reference to a map of part of the Austrian territory, merely premising that the pins made use of are a little larger than the ordinary pins, and that they have glass heads of various colours, and about the size of a small pea. Thus—

White transparent heads represent—	Cotton and linen manufactories.
Blue heads represent ...	Weaving establishments, thread manufactories.
Green	Print-works.
Orange	Chemical works.
Opaque white	Paper manufactories, paper-mills, &c.
Bluish-green	Copper works.
Transparent glass	Glass-works.
Dark blue	Pottery, china and earthenware.
Crimson red	Brick and tile works.
White with a red spot...	Sugar manufactories.
Transparent yellow......	Breweries, distilleries, alcohol works, liqueurs, vinegar, oil works, &c.
Black	Coal-pits, mines of black lead or plumbago, alum, lead, and iron.
Red	Ironmongery, iron and steel works.
Yellow	Wine districts, grapes of superior quality.

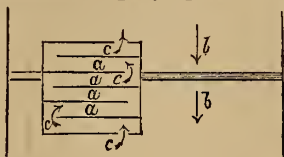
Of course, many improved modifications of the system may be made, and many such will no doubt be required to suit particular cases; but we trust the explanation that has been given from one particular map will be sufficient to render the principle simple and easily understood.

Fisheries and Management of Rivers.

An ingenious method of constructing weirs at fish passages, by means of which fish are enabled to ascend rivers, notwithstanding the damming up of the water for mill-power, navigation, and other purposes, is exhibited in connexion with the fisheries of Ireland. This subject is one of vast importance, as it is one great means of preserving from destruction a valuable amount of human food, which, we grieve to say, has been recklessly and wantonly destroyed in this country. Fish, however, are still to be found in the great rivers and lakes of Ireland; and it becomes us to adopt every means of preserving the fish concurrently with the more general introduction of manufactures. Suppose a weir constructed across a river with a simple overfall for the water, it is only a few powerful fish that can ascend at all against such an obstacle; and even for any fish, the power of ascending by leaping is limited to a very few feet.

In the Irish rivers, when fish passages are used with the weir, the latter does not extend quite across the river, but a passage, 10 or 12 feet wide, is left at one side, either oblique or at right angles to the course of the river. This passage has an inclination of about 3 or 4 to 1; so that if there were no obstruction across it, the water would flow over it at such a rate that no fish could ascend against the current. Instead of being entirely open, however, there are small dams, *a a a*, fixed across it, with only a small opening alternately at either end of each. This contrivance produces such a depth of water over the inclined passage, and so diminishes its velocity, that fish are able to ascend without difficulty, as will be better understood from the accompanying sketch.

Here the course of the river is shown by the large arrows marked *b b*; the small dams across the fish passages are shown by *a*, while the small arrows, *c*, show the course taken by the fish in ascending.



Gas Works.

M. Bernier, of Paris, exhibits a very compact and neat gas apparatus for making oil-gas, capable of supplying 150 burners. The apparatus consists of one retort set in its furnace, a short hydraulic main, and a syphon for the introduction of oil into the retort. A pipe leads from the hydraulic main to a small underground cistern, which receives the tar. The condensing apparatus consists of seven single upright pipes, with bends at top, and a rectangular box at bottom. There is also a small circular purifier, with eight sieves or screens. A pipe leads to the gasholder, and is provided with a slide-valve for admitting or shutting off the gas as required. The gasholder is included in the apparatus, the cost of which, with one additional retort and everything ready for fixing, is 5,000 francs, or £200. This simple and efficient description of private gas-works is used in many factories, cotton, and silk mills, throughout France.

Coal Mines.

An interesting model on a large scale shows the mode of working an almost vertical bed of coal, about 2 feet in thickness, at Angier, near Valenciennes. The coal is nearly vertical, and is overlaid by almost horizontal beds of chalk and tertiary strata.

Well-sinking Machinery.

A variety of boring-tools are exhibited by M. Mulot, who has distinguished himself so successfully by the great Artesian well at Grenelle, which is 1,800 feet in depth. Besides all kinds of apparatus for boring, M. Mulot exhibits machinery on a very large scale for sinking wells of considerable size, even up to 12 feet in diameter. The apparatus consists of an immense mass of iron in the form of a cross, with cutters at the extremity of each bar.

The Juries of 1844 and 1849 conferred the honour of the gold medal on Messrs. Mulot, of Paris, and Degouzée and Laurent, also of Paris, for their boring apparatus. M. Mulot supplies, for £52, a boring apparatus for the use of agriculturists, which will bore and bring up specimens from the depth of 3½ metres, or about 11 English feet. He also sells another for £8, which will bore as deep as 10 metres, or nearly 33 feet. This apparatus would be found of great service in exploring soils and subsoils, both for agricultural and geological purposes, and might often serve to throw great light on the operations of the engineer in reference to railways, water supply, and other matters.

Messrs. Degouzée and Laurent will undertake to bore to the depth of 200 feet English for about £120, and to go 1,000 feet deep for £600.

Works of Pottery.

The Belgian articles in fire-clay are worthy of attention, as they appear to be of very superior quality. Amongst them are gas-retorts, sewer and water pipes, fire-bricks, tiles, and a number of other articles, moulded in a variety of forms, from the Society of Vieille Montagne, and from a company established at Audenne, near Namur.

Heating Apparatus.

The French have for some time used three principal methods of heating their public buildings; namely, heating by steam, by large hot-water pipes, and by hot-air pipes. There are serious objections to each of these methods. Heating by steam is said to be so expensive, that the cost of it can rarely be incurred. Heating by large water-pipes is also expensive, and requires great alterations to be made in most buildings before it can be adopted. On account of the size of the pipes, it is difficult to make the water circulate properly without having the fires lighted long before the heat is required. Add to this the difficulty of procuring pipes sufficiently impermeable to withstand the pressure and the occasional annoyance of leaks, which speedily cause buildings to be inundated with large volumes of water. The objections to hot-air pipes are more numerous still. They are confessedly unwholesome aud dangerous. Three great buildings in three of the principal capitals of Europe owe their destruction to hot-air pipes; namely, the Houses of Parliament in London, the Winter Palace of the Emperor of Russia at St. Petersburg, and the Italian Theatre at Paris. The heat which they diffuse is also unequal in its distribution, and the cost of fuel to heat the apparatus is excessive.

Several eminent French manufacturers have considered Perkins's hot-water apparatus free from most of the preceding objections, and have accordingly commeuced its manufacture. The pipes used here are of wrought-iron, of very small diameter, and the heating is produced by the constant circulation of a very small body of water through a great length of pipe. At the points from which the heat is to be diffused, the pipes are dispersed in coils of proportionate extent. Accordingly, specimens of Perkins's heating apparatus are exhibited by M. Gallibron, of Paris, and other manufacturers.

Although the small pipes may be an improvement on the old French modes of heating, our own private opinion, formed from very extensive experience, is, that any system of heating air by meaus of hot-water pipes is far from wholesome. It destroys the humidity of the air, and this moisture can never be properly replaced by evaporatiou or any other contrivance. The radical defect of all the systems of warming by pipes is the want of ventilation and circulation; and till this be remedied, none of them will be wholesome or free from injury to the breathing organs. Perkins's system is admirable, however, for many purposes apart from domestic heating: for instance, for heating hot-beds and other places where artificial heat is required, as baths, incubating apparatus, &c. It is also said to have been used with great advantage and economy for heating water in readiness for locomotive engines on the Orleans Railway. The application of hot pipes for this purpose is said to have effected a saving of nearly 50 per ceut.

Some extensive apparatus is exhibited by M. Cerbelaud, of Paris, for heating churches with hot air.

(*To be continued in our next.*)

ENGINEERING IN HOLLAND,

WITH THE DESCRIPTION OF A NEW PUMPING-ENGINE.

We have been favoured by an esteemed correspondent in Holland with the following observations on draining submerged lands, and describing some recent works erected for this purpose, which will be found of considerable interest to our readers.

NEW PUMPING-ENGINE FOR DRAINING DISTRICTS.

Holland, and especially its western part, lying nearest to the sea, contains a great area of land, which, by its natural position, or by the continuous extraction of peat for making turf, is lower than the surrounding country. There are also many lands which are in the same position by being drained lakes or meres, as lastly the great Haarlem Lake, which, having covered an area of about 45,000 acres, bears now magnificent crops of wheat, rape-seed, barley, &c. All these lands must be continuously discharged from the rain-water falling in, and from the water descending from the higher levels and percolating through the soil. This has been effected since immemorial times by means of windmills actuating scoop-wheels, vertical or horizontal Archimedeau screws, or, in some few cases, wooden suction-pumps.

The wind, however, not always blowiug at the time most required, these lands are often inundated at the very time they should be cultivated, or in wet summers, at the time the crops are in full growth, thereby causing great delay and damage. From this cause the steam-engine, not being dependent on time or place, has superseded in many cases the uncertain force of the wind; and, by its application to this particular purpose, attracted the attention of many engineers to this interesting branch of engineering science, which before was almost totally in the hands of old-fashioned millwrights. Hereby more attention was paid to the different means for lifting water, and many an improvement followed of course.

Many of the formerly used machines have the great defect that they are useful only in very narrow limits. The scoop-wheel, for example, is a very good machine for lifting water as long as the level, to or from which the water has to be lifted, is not very variable, and the difference of the levels is not so great as to necessitate the use of wheels of uuusually great dimensions. When not very accurately made, they have also a great loss, by the water returning to the lower level; this is also the case with the Archimedean screw, which, however, allows of a far

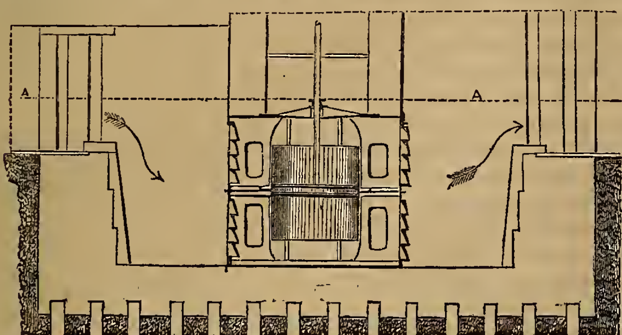


Fig. 1.

greater lift. But by the great rise and fall of our rivers, in which the most part of these lands discharge their water, these machines are very unfit for this purpose. Thus, where the height to which the water has to be lifted is considerable, two, and even three, of these machines are to be erected at different levels; the lower discharging their water in artificial reservoirs, called *boezems*, from which the higher draw their water to bring it to a higher level. This induces, however, often a great outlay of capital, by the great earthworks required, aud by the multiplying of the machines.

By the use of suction-pumps this evil is avoided; such pumps being capable of a much greater lift, and the power required being proportional to the more or less height to which the water is to be lifted. These qualities of the suction-pump determined their use for draining the Haarlem Lake, which has been effected by three steam-engines, each having a power of 350 H.P. (nominal). The first erected, called the "Leeghwater," moved eleven suction-pumps, having each a diameter of 1·60 met. (63 inches), and a stroke of 3·00 met. (10 feet), delivering at each stroke about six tons of water each. The two other engines move each eight pumps, having a collective capacity equal to the eleven pumps of the first erected, so that the total quantity of water lifted at each stroke by the three engines amounted to no less than 189 tons.

Notwithstanding the perfect success which has followed the drainage of the Haarlem Lake by suction-pumps, they possess many disadvantages—one of the greatest being the valves in the bucket, as also the foot-valves, considerably contracting the waterway, thereby causing a great loss of power. To avoid these disadvantages, and, in the mean time, to reduce, as much as possible, the space occupied by the machine, thereby diminishing considerably the cost of erection, which in all such works is commonly very heavy, owing to the heavy foundations required, the Chief Government Engineer, H. F. Fijnje, devised the use of double-acting forcing-pumps, for the purpose of draining, which invention was patented in the year 1845. For this purpose the pump is to be placed beneath the lowest water-line, so that the water will always follow the piston in obedience of its gravity, and is enclosed in a square pit, of which two side walls and the bottom are built in brick, lined with cast-iron; the two other sides are closed by strong cast-iron frames, containing hanging-valves, opening on the one side inward, and on the other side outward. This pit or chamber is divided into two equal parts by a strong horizoutal iron ceiling, firmly connected to the sides, as well as to the top and bottom, in the centre of which the pump is fixed, leaving ample space between the bottom and the cover for the water entering or leaving the pump, so that the waterway is in no part contracted. The whole chamber is covered by strong iron plates connected to the side walls and frames, in the centre of which is screwed down a loose cover, provided with a stuffing-box for the passage of the piston-rod, which is connected to a plain piston.

This description will sufficiently explain the annexed drawings, Fig. 1 being a vertical section of the pump-chamber in the direction of the water entering and leaving the pump; and Fig. 2 is a plan.

The first application of this device has been effected in a tract of land enclosed by two rivers—the Maas and the Waal—which land, by the peculiar nature of the soil, and by its position, was always wet, especially when the water in the rivers rose to any considerable height.

This work was erected in the year 1845, and its success has been perfect; the lands being always freed from the surface-water, and, accordingly, their value augmented to a considerable extent. The land drained by this engine has an area of about 10,000 acres; the greatest height to which the water is to be lifted seldom surpassing 2·50 met. (8 feet $2\frac{1}{2}$ inches), this height being variable owing to the great rise and fall of the river Maas, in which the water is discharged. The

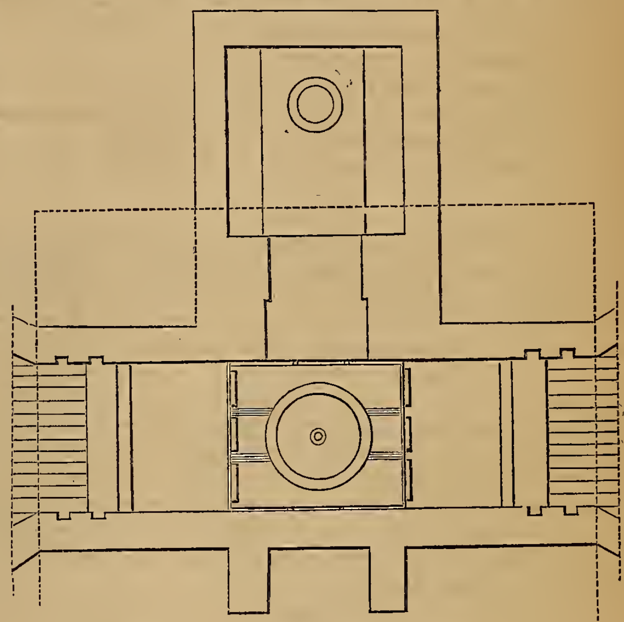


Fig. 2.

pump has a diameter of 2·04 met. (6 feet $8\frac{1}{4}$ inches), with a stroke of 2·20 met. (7 feet $2\frac{5}{8}$ inches), and is actuated by a double-acting Cornish engine, nominally 60 H.P.

A second application of this scheme has now been effected in an adjacent district, called the Boemelerwaard, enclosed by the same rivers, but having an area of about 24,000 acres. Two engines, at a distance of about one mile from each other, have been erected, each of 100 H.P., which can raise the water even to a height of 4 met. (13 feet $1\frac{1}{2}$ inch). Each engine actuates a forcing-pump, of a diameter of no less than 2·24 met. (7 feet $4\frac{1}{4}$ inches), with a stroke of 2·20 met. (7 feet $2\frac{5}{8}$ inches). Each chamber, in which the pumps are placed, has an internal width across the building of 2·85 met. (9 feet $4\frac{1}{4}$ inches), and in the direction of the length of the building of 4 met. (13 feet $1\frac{1}{2}$ inch); the bottom lies 4·30 met. (14 feet $1\frac{1}{4}$ inch) under the low water-line, and the height between top and bottom is 3·81 met. (12 feet 6 inches). The total number of valves to each pump is forty-eight, twenty-four to each side, so that at each stroke, twelve valves are opened on the one side, and twelve on the other. Each of these valves has a length of 0·975 met. ($38\frac{3}{8}$ inches), and a breadth or height of 0·215 met. ($8\frac{1}{2}$ inches), and is constructed of oak, lined with plate-iron. The mass of iron forming these chambers, including the pump, with piston and rods, valves, &c., amounts to about 100 tons each. The foundation consists of concrete, being the most suitable material for all works lying at such a depth beneath the level of the ground. The pump-rod is attached to a main lever, having a length from centre to centre of 9 met. (29 feet $6\frac{3}{8}$ inches), at the other end of which is attached the steam-piston, having a diameter of 1·10 met. ($43\frac{5}{16}$ inches), and a stroke the same as the pump. The engines are in other respects similar to the double-acting Cornish engines; the valve-gearing alone has some peculiarities for producing an easy motion of the pump-valves, which otherwise, by the great velocity of twenty single strokes per miuute, would close with a shock, while, at present, by the peculiar motion given to the engine, this closing is effected without any disturbing effect. By the drawing of the pump the level of the water on the inside is depressed about 20 centim. (8 inches), and is prevented from returning by the subsequent stroke, so that almost no motion can be perceived in the water. At the outside only a continuous rise and fall is to be seen, without any disturbing effect to the walls.

To each of these engines belong three cylindrical boilers, with internal flues, the boilers having a diameter of 2·20 met. (7 feet $2\frac{5}{8}$ inches); diameter of flue, 1·20 met. (3 feet $11\frac{1}{4}$ inches), and length, 8·5 met. (27 feet 10 inches), designed to work at a pressure of three atmospheres; so that, in case of the condensing apparatus being out of order, the engines may be worked without condensation. The engines and pumps are constructed at the Minerva Works of Messrs. J. Nering Bögel, and Co., at Isselburg, near Emmerich, Prussia; while the boilers are made by Messrs. J. L. Nering Bögel, and Co., at Deventer, Holland. Both these engines are erected in this year, and have performed exceedingly well, delivering at each stroke 8 cub. met. water, or, with a velocity of twenty strokes, 160 cub. met. (about 160 tons) per minute.

Another engine on the same principle, but of only 17 H.P., has just been erected, working without condensation, and designed to drain a small lake, having an area of 420 acres; and two others, one of 42 and one of 200 H.P., are to be erected in the course of next year.

These engines are also especially adapted for lands, which, though not lying so low as to run the risk of being covered by the water, are, however, too low to be drained by pipes, these having no good discharge for their water. By a suitable arrangement a good discharge for the pipe-drains could be constructed, and pumped out by a similar engine, which, in this way, would discharge the drainage-water of a whole district at a very low rate.

Another proposal has been made, viz., to inundate the lands adjacent to any river in the winter, by the water of the river, and afterwards pumping it out, so that the fertilising quality of the river-water may be made available for the manuring of those lands in the same manner as the Egyptians use the Nile.

COMPARATIVE RESULTS OBTAINED FROM THE SCREW AND PADDLE-WHEEL IN THE STEAM-SHIPS "HIMALAYA" AND "ATRATO."

The performance of these vessels affords a valuable opportunity for comparing the relative efficiency of the screw and paddle-wheel as applied to large ocean steamers; and particularly so, as they are, with only one or two exceptions, the largest afloat, and approximate so closely to each other in size and speed. They are built of the same material, *iron;* commenced running in the same year and from the same port; and may be considered to offer, in all respects, a fair exposition of their respective systems of steam propulsion.

In one vessel, we have the direct-acting screw-engine of Messrs. Penn, simple, compact, and light; its screw propeller little more than 10 tons in weight, and yet fully equal to its task of transmitting the power of the engines for the propulsion of this huge ship.

On the other hand, there is the ponderous beam or side-lever engine, necessarily complex and bulky, with the feathering paddle-wheels, each probably weighing about 70 tons, and requiring enormous paddle-boxes and framing to support them.

In one case there are four screw-shaft bearings to look after and keep in order; in the other, 128 working parts requiring care and attention.

The first cost of the *Himalaya's* screw would be under £400; the feathering wheels of the *Atrato* would probably cost not less than £5,000.

We will now give, in a tabular form, some dimensions of the vessels and their machinery, speed at measured mile, &c. :—

VESSELS.	SCREW. *Himalaya.*	PADDLE. *Atrato.*
Built by	Mare, of Blackwall.	Caird, of Greenock.
Engines	Penn & Co.	Caird.
Launched	May 24, 1853.	Aprl. 26, 1853.
Length between perpendiculars	340 ft. 6 in.	318 ft.
Ditto at load line	336 ft. 6 in.	315 ft.
Breadth, extreme	46 ft. 1 in.	42 ft.
Depth from underside spar-deck to top keel	34 ft. 6 in.	36 ft.
Tonnage, B.M.	3,550 tons.	2,721 tons.
Tonnage, register	$2,327\frac{8}{100}$ tons.	$2,600\frac{75}{100}$ tons.
Stowage for coal	1,100 tons.	1,440 tons.

MACHINERY.	SCREW. *Himalaya.*	PADDLE. *Atrato.*
Nominal H.P. of engines	700.	900.
Diameter of cylinders (effective)	$77\frac{3}{4}$in.	96 in.
Stroke of pistons	3 ft. 6 in.	9 ft.
Cubic contents of both cylinders for one double stroke	462 cubic ft.	1,807 cub. ft.
Diamcter of screw and of paddle-wheels	18 ft.	36 ft. 6 in.
Number of blades and of floats in each wheel	2.	15.
Length of screw and size of each float	4 ft. 8 in.	12ft. × 4ft. 6in.
Pitch of screw (uniform) is six times its length, or	28 ft.	
Total surface in screw-blades and in all floats of both wheels	....	1,620 sq. ft.
Total number of boilers	4.	4.
Total length of ditto, fore and aft	43 ft. 6 in.	46 ft.
Breadth of ditto	9 ft. 3 in.	12 ft.
Depth of ditto	12 ft. 3 in.	18 ft. 9 in.
Number of furnaces	24.	24.
Width of each	2 ft. 10 in.	3 ft. 3 in.
Length of fire-bars	7 ft.	7 ft.
Total area of fire-grate	475 sq. ft.	546 sq. ft.
Total heating-surface in boilers	10,910 sq. ft.	16,640 sq. ft.
Total steam space	2591 cubic ft.	2,800 cub. ft.
Number of chimneys	1.	2.
Diameter of each	8 ft.	6 ft. 8 in.
Area of chimneys, total	$50\frac{1}{4}$ sq. ft.	70 sq. ft.
Pressure of steam in boilers	14 lbs.	17 lbs.
TRIALS AT MEASURED MILE IN STOKE'S BAY.		
Date of trial	Jan. 13, 1854.	Mar. 10, 1854.
Draught of water, forward and aft	15ft. 3in. frd. 18ft. 3in. aft.	16ft. 4in. frd. 16ft. 8in. aft.
Ditto, mean	16 ft. 9 in.	16 ft. 6 in.
Coal on board	700 tons.	290 tons.
Speed of vessel in knots per hour (mean of several runs)	13·78 knots.	13·97 knots.
Ditto in statute miles (ditto)	15·87 miles.	16·08 miles.
Immersed midship section	560 sq. ft.	544 sq. ft.
Displacement	3,220 tons.	3,070 tons.
Revolutions of engines (mean)	59.	$18\frac{1}{4}$.
Gross indicated H.P. (mean of all runs)	2,050.	3,070.
Coefficient of I.M.S., or speed in knots per hour cubed × I.M.S. ÷ indicated H.P.	716.	494.
Coefficient of displacement or speed in knots per hour cubed × cube-root of square of displacement ÷ indicated H.P.	279.	171.
Slip of screw per cent	15.	
Ditto of paddles, taking axes of floats as centre of pressure		23.

The extraordinary fact which presses itself on our notice from the foregoing details of trials, consists, as it appears to us, in the difference of power required in the two vessels to produce a nearly identical speed. They are both built for the highest speed, and have fine lines, both in the forward and after bodies, the run of the *Himalaya* being longer and cleaner than the other, to suit the screw-propeller; and we must also remark that the *Atrato* had not been docked for some time previous to her trial, which was not the case with the *Himalaya.* But these circumstances will not by any means account for the *fact,* that 2,050 H.P., economised by the screw, propelled the *Himalaya* at about the same speed as 3,016 H.P., transmitted by paddles, propelled the *Atrato.* And the question naturally arises—By what means was the difference, or 966 H.P., absorbed or expended in the paddle steamer? And to this question we invite the earnest attention of our readers, for on its solution depends the extension of our knowledge of the screw-propeller, of the true nature of the action of which so little is thoroughly understood, as it in practice so often presents us with apparently anomalous results, and the value of which as a propeller for large ocean steamers (at any rate) has never been more prominent than in the example we have described.

In conclusion, we beg to say that, although we must decidedly express our opinion of the superiority of the screw over the paddle, as proved by the trials enumerated, it is our pleasing duty to bear ample testimony to the successful results obtained from both these noble vessels. They are magnificent specimens of naval architecture and of engineering skill, and both have highly distinguished themselves by their rapid voyages.

We will shortly lay before our readers some interesting investigations on the peculiarities developed by the screw of the *Himalaya* and other vessels.

ENGINES OF THE "BATAVIER."

We this month give an illustration of the engines of the Netherlands Steam-boat Company's new iron paddle-wheel steamer *Batavier*. Ship and engines built at the Company's establishment at Fyenoord, near Rotterdam. To run between Rotterdam and London.

The principal dimensions are as follows:—Length on deck, 200 feet; breadth between the paddle-boxes, 26 feet; depth of hold, 15 feet; with a large saloon, and ladies' cabin on deck, having very commodious sleeping-berths below.

The engines are on the inclined system—a kind of engine that has always been a favourite with this Company, they having, during the last twenty-five years, made a great many, both for mercantile and war purposes, a choice of system in which they are confirmed by seeing it adopted of late years by eminent engineers, both in England and America, after having been long laid aside.

The cylinders are 48 inches diameter, with 5 feet stroke, and make about thirty revolutions per minute; wheels, 20 feet diameter, with revolving floats, twelve in number. The framing is of wrought-iron hollow beams, made of ⅜ plates, connecting the cylinders and main bearings, inside of which are fastened the guide-frames for the piston-rods, of which there are two to each piston, an arrangement which admits of a very simple connecting-rod and short cross-heads. The slides are worked direct from the shafts, only one lever being required for each engine to carry the eccentric pin, both levers being carried on one weigh-shaft—that on the one engine is keyed direct on the shaft, while the other is keyed on a boss, and which works *on* the shaft.

Two tubular boilers, circular at top, the centre space at top being occupied by a cylindrical steam-chest, laid horizontally, and connected to the boilers by two short pipes on each side, the advantages of which arrangement are—besides occupying space which would otherwise be vacant—that, if there is any tendency in the boiler to *prime*, there will be less chance of the water getting into the cylinders than when the steam is taken direct from the boiler.

The engines and boilers were constructed by Mr. D. Christie, Manager of the Company's establishment, and have given very satisfactory results, the ship having made the passage from Rotterdam to London in fifteen hours and a half steaming, being an improvement of about eight hours on the ordinary voyage. The vessel is a beautiful sea boat, being what is technically called "easy and dry;" and is altogether a credit to the Company's establishment and its conductors.

BRUNTON'S IMPROVEMENTS IN METALLIC PISTONS.

Mr. William Brunton, of Camborne, a name well known to most of our readers, has recently patented a means by which the rings of metallic pistons can be set up or slackened out at pleasure, without the necessity of taking off the cylinder-cover or removing the junk-rings of the piston, and insuring, by the means he employs, equal pressure upon each of the springs used to press out the piston-rings. And this he effects in the following manner, as will be readily understood on reference to the wood-cuts below:—

A plug is fitted into a round hole in the centre of the piston, and grooved with as many grooves as there are springs in the piston. These grooves are not cut parallel with the exterior of the plug, but deep at one end and extend quite to a point at the other, forming an inclined plane or wedge: the bolts, which are connected to the springs, rest in these grooves. When the piston is first inserted, they are fixed in the lowest part of the groove or bottom of the incline. Through the plug a screw is placed with a conical collar, which is fitted and ground into the interior of the junk-ring of the piston, a square head on the screw passing through and projecting about 1½ in. outside the junk-ring. In the centre of the cylinder-cover a hole is made for the insertion of a box-spanner, which fits the head of the screw that projects out of the junk-ring. When the piston requires tightening, the plug in the centre of the piston is made by the spanner to recede inwards, and the bolts fixed to the springs are thrust forward to a greater distance from the centre of the piston by the inclined grooves in the plug, thus causing increased pressure on the back of the piston-ring.

The arrangement described is suited for horizontal engines, with a single piston-rod working through one cover only; or for vertical cylinders, where the bottom of the cylinder can be reached from below. And it is such an arrangement the accompanying diagram Figs. 1 and 2 relate to. But Mr. Brunton has also contrived a suitable means of acting upon the several springs simultaneously, where the centre plug cannot be used for the purpose, either from the position of the cylinder, or the piston-rod running through both covers.

Fig. 1.

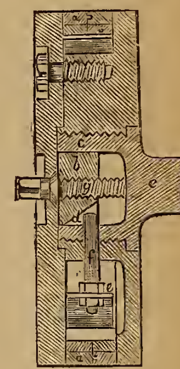


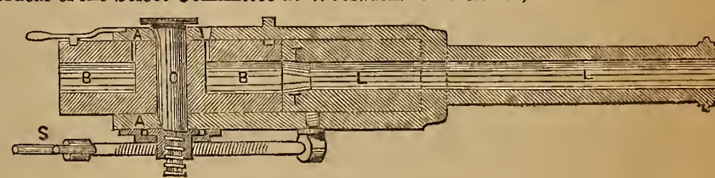
Fig. 2.

Fig. 1 is a plan of the improved piston, the cover-plate being removed; and Fig. 2 is a section. *a a*, being the piston-rings; *b*, the plug; *c*, the recess in the piston-rod end; *e e*, the springs; *f f*, the tightening bolts; *g*, the regulating screw which causes the grooved plug to travel forward and so project the tightening-bolts and press against the studs and springs, which, in their turn, press the interior of the spring, and expand it uniformly.

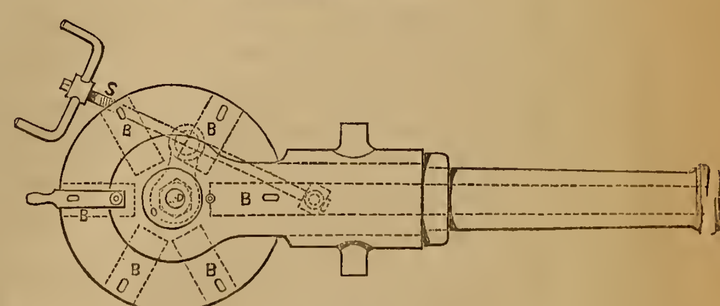
GOWER'S PATENT BREECH-LOADING CANNON.

During the present war more has been done in the way of producing various ingenious contrivances connected with large and small arms, projectiles, and other warlike implements and *matériel*, than was effected in the preceding thirty years.

Many as have been the attempts to produce a thoroughly good and practically serviceable breech-loading cannon, none have yet successfully withstood the tests applied, or passed successfully through the ordeal of the Select Committee at Woolwich. Mr. Gower, of the Eastern



Sectional Elevation.—Fig. 1.



Plan.—Fig. 2.

Fig. 3. Fig. 4. Fig. 5. Fig. 6.

Counties Railway Works, at Stratford, has invented and patented improvements in cannons and projectiles, and is a candidate for honours in this branch of industry. He has contributed a very simple and ingenious contrivance, of the revolving wheel breech gun order, applied to cannon, and has exhibited attention to the details in the contrivance, which meets many of the objections raised against this class of arm.

The improvements consist in constructing the cannon or piece of ordnance in two pieces of wrought or cast iron, or any other material generally used. One piece forms the breech or set of chambers, B B, Fig. 1, and the other the barrel, L L, Fig. 1. This piece is made in the shape of a wheel (see Fig. 2), and is mounted on a vertical axle or pin (O, Fig. 1), and the chambers are then bored from the periphery towards the centre. The diameter of the breech-chamber is slightly larger than the diameter of the barrel, except for a short distance from the breech end of the latter, which is conical, so that at the joint, T T, both diameters are the same. The breech-piece revolves on the pin, O, and may have several charges at one time, to be afterwards alternately fired. To prevent windage at the joint, T T, when the gun is fired, the pin, O, which is wedge-shaped at its back, where it passes through the straps at A A, is drawn tightly down by a nut and lever on the screwed part, D, worked by the screw, S, at the bottom of the pin. C is a catch which ensures the breech and barrel being in a line.

The shot or projectile (see Figs. 3, 4, 5, and 6,) is made of cast-iron, and is elongated, having a conic point. It may either be solid, or be cast with holes through it, at a pitch of thread sufficient to give it, by the action of the atmosphere through the holes, a rotative motion in its flight. To prevent any loss of explosive power, a wadding of iron, or other material, is placed over these holes (see Fig. 4) before it is fired, which drops off as soon as the shot has left the muzzle of the gun, owing to the pressure of the atmosphere against it. Rings of lead or other soft material are placed in grooves cast or cut round the shot (see Figs. 4 and 6), which project sufficiently above the shot to form a tight fit in the barrel, thereby preventing windage as the shot is fired, and, at the same time, prevents any injury to the barrel by abrasion as the shot passes through it.

THE STEAM-BOILER EXPLOSION

At Messrs. Hall and Boyd's Sugar-House, Ratcliffe-highway, November 12, 1855.

In recording the fact that several explosions, attended with great loss of life, have occurred close on the eve of our publication, we shall, in order toward supplying a want expressed in our last month's article on this subject (p. 255), give the exact *data* relating to the above explosion. For this purpose we have caused a proper survey of the boiler to be made, and such examination of the circumstances on the spot as is necessary to a complete elucidation of the disaster and its cause.

This boiler was made by Messrs. Miller, Ravenhill, and Salkeld, of Blackwall, and erected some three or four months ago; it is one of *four* of nearly similar form and dimensions, all made by the same firm, within these two years, for the same works—a sugar refinery of great extent. These works are partly of recent construction and enlargement, and rendered very conspicuous by the erection lately of a large chimney-shaft, 170 ft. high, near the entrance to St. George's-street east, better known as Ratcliffe-highway. These four boilers all communicated their smoke to this chimney, and were situated very nearly in, not to say dangerous contact with, its base, for a slight alteration in the direction taken by the boiler in bursting might have easily brought this immense structure to the ground, which would have entailed at least tenfold more destruction to life and property.

At the time of the accident (about two o'clock P.M. on Monday, the 12th November,) only one of these four boilers was at work, which, together with another, at a distant part of the premises, were supplying steam to the pipes that pass through the works, besides supplying a 20-horse engine. The steam for this engine was required at the time to be higher than usual, on account of its having to work a well-boring machine; in fact, as stated by the fireman, at about 48 lbs. per square inch, at which pressure he observed it, as indicated by the steam-gauge, three minutes before the explosion. The usual pressure required for the purposes of the sugar manufacture was only 35 lbs. per square inch. What value is to be attached to the accuracy of this man's observation it would be hard to say, as we afterwards found, from a perfectly independent and impartial party, that the weight represented by him to have been on the only safety-valve (one of 5 in. diameter) indicated only about 40 lbs., or, at most, 42 lbs. per square inch; the presumption would naturally arise that some additional weight, not yet produced, had previously been added. This fireman also stated that he was on the top of the boiler, only three minutes before the explosion, for the purpose of ascertaining the state of the steam and the height of the water, the latter being stated by him to be at its proper height by the gauge, he being solely responsible for the performance of that duty. The man employed as stoker in the fire-hole (a common labourer) being one of the men killed.

These preliminary particulars are, in some measure, necessary to be stated here, because deficiency of water-supply is one of the peculiar conflicting points so frequently occurring in personal evidence relating to boiler explosions; and, it must be admitted, that a coroner's court is far from being a suitable place to pursue such investigations. It is far from our desire to throw doubt on the testimony of any one; but the serious importance of the subject naturally gives rise to the question,—why was there a necessity to go on to the top of the boiler in order to inspect either the water or the steam-guage, although it was a very convenient place for loading or *unloading* the safety-valve?

Our illustrations will render very little description of the boiler necessary. It will be seen that the case is the very common one of collapse of the internal flue-tube, which, as well as many other circumstances, are very similar in their character to those of the Chiswick explosion, recorded in The Artizan for August last; and our readers, who recollect our remarks on that case, will find them very applicable to this.

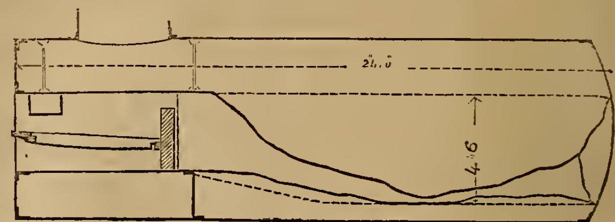


Fig. 1.

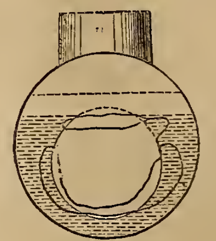


Fig. 2.

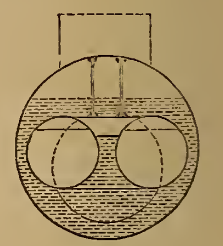


Fig. 3.

It will be seen that this is a cylindrical boiler, of the double-furnace class now frequently made. The two circular furnace-tubes, 3 ft. 2 in. in diameter, terminating, by means of an elliptical connecting-piece, in one large cylindrical tube of 4 ft. 6 in. in diameter, near the middle of the length of the boiler. The object of this arrangement being to cause the flame from one fire to "burn the smoke" of the other, by a system of alternate firing not always very effective. In this instance, it was supposed to be assisted by the addition of Bristow and Attwood's patent arrangement, described in this Journal at 196, Vol. 1855. This, however, it is fair to say, could have nothing whatever to do with the explosion. It is true, that the connecting iron pipe at the front of the two furnaces required the support of two wrought-iron stays to the top of the boiler, but neither of these had given the least indication of rupture, although three other similar stays near the commencement of the large tube did so. Two of these we found drawn out of the rivet holes in the roof of the tube by the depression and collapse of the latter; and the third had broken in the eye of the bolt, leaving a fracture of about one square inch in sectional area. This clearly enough indicates that the amount of longitudinal strain on the stay at that point could not be much less than 15 to 20 tons. This estimate, however, if applied to account for the steam-pressure at the time, must be considerably reduced by the amount of leverage between this point and the place where the first depression of the roof of the flue-tube took place, which must have been near to the back end of the boiler.

On examining the inside of the boiler a few days after the explosion, we found clear and perfectly unmistakeable evidences of the water having been too low, in a clear and well-defined mark left by the water-surface reaching across the concave end of the boiler a full *inch* below *the roof of the tube*, and another, apparently more recent, but perfectly well-defined, *an inch below that*. Several practical boiler-makers present were also witnesses of this fact, and agreed with us that all doubt on that point was thereby settled.

The question, however, as to how the explosion was brought about, after the water was found to be too low, still remains to be answered satisfactorily. It admits of, and has received, a great variety of explanations. Some contending for the sudden generation of some unknown "highly-elastic *gas*," a doctrine which we have always considered simply absurd, seeing that the effects produced may be just as easily accounted for by highly-elastic *steam*, combined with the effects of leverage and sudden flexure of the parts, at the moment, or instantly after, the first rupture of the material.

A fall of 2 in. in the level of the water surface would readily lay bare 12 or 15 square feet in area at the back end of the large tube, while, owing to the inclination of the boiler to the front, the furnace-tubes might not be uncovered. Now, in this condition of things, any movement or agitation of the water, caused either by the admission of feed-water, the sudden opening of any outlet to the steam, or by any movement of the safety-valve by either loading or *unloading* it, and particularly the latter, would cause the water to flow over the overheated tube, and generate quite sufficient steam to produce all the effects we have seen, and certainly more effectually in destroying the boiler itself than could have been done by gunpowder.

The shell of the boiler was not in any way injured that we could perceive. It was 24 ft. long by 7 ft. 6 in. diameter internally, with segmental end at the back, and made of excellent half-inch plates, well put together, and caulked both inside and out. We had no opportunity of testing the strength of the iron; but allowing it to sustain 5,000 lbs. per square inch sectional area, which is only one-third the strength of common Staffordshire iron, it might be worked with the greatest safety with steam at 55 lbs. per square inch pressure.

The iron of the tube, like that of the shell, is of excellent quality, and full 7-16ths thick; therefore, allowing the same rate of resistance as the shell, it should have borne a pressure of about 80 lbs. per square inch on its *circular* portion, so long as it retained that form; that, however, could not be for many minutes after the roof of the flue was laid dry.

We do not here take into account the great probability that the steam became surcharged with heat, and the effects likely to be produced therefrom, because those effects would be merely superadded to those above described, on which subject we beg to refer the reader to our article in last month's ARTIZAN (p. 255) on the explosion at the Kebblesworth Colliery.

OUR HIGH-PRESSURE VESSELS OF WAR.

In our numbers for April and June of the present year, we illustrated the high-pressure block-ships, the *Pembroke* class, boilers by Maudslay, Sons, and Field; the *Cornwallis* class, boilers by Penn and Son. In our remarks we then stated, "That the steam-department of the Royal Navy deserves no small meed of praise, as taking the lead in a very important improvement in practical science."

We take the opportunity of the return of the Baltic Fleet to the English ports to remark, that we hear from various sources, on which we can put perfect confidence, that all the high-pressure vessels, especially the gun-boats, have fully answered the expectations of those who, like ourselves, were confident in the success as well as the manifest advantages of high-pressure steam.

We are glad to hear, as it reflects great credit on the constructors, that the defects of this *host* of gun-boats (though they have been constantly under steam for many months) are very trifling indeed. We are assured that these gun-boats are admirably adapted for their work in the shallow waters of the Baltic. We have heard some complaints that sufficient attention has not been paid to the ventilation of the engine and stoke hold. This we can easily believe, as, from the hurried manner they were fitted out, this cannot be wondered at. We hope that attention will be paid to this point by the proper authorities, as its importance cannot be overstated.

We would also remark, that the comparative freshness of the water in the Baltic has been favourable to the boilers, and that the effect of salt-water has yet to be fully ascertained; on this point the Admiralty have issued a very judicious circular, which has been kindly sent us. For the information of our numerous naval readers we insert it here.

On the Care and Management of High-Pressure Tubular Marine Boilers.

Several ships and vessels having been recently fitted with high-pressure tubular boilers, and no experience having yet been obtained in the working of such boilers with salt-water, their Lordships desire all officers, under whose command these vessels may be placed, to impress on the engineers the necessity of paying more than ordinary attention to the boilers under their charge, both in maintaining the proper heights of water, and, by adequate blowing off, in keeping the degree of saltness below that which, in low-pressure boilers, would be no serious injury.

Even when full speed is required, these matters must be regarded as of paramount importance, for any neglect may cause an amount of permanent injury to the boilers, which would far outweigh the temporary advantages of a slight additional speed; and, until some experience has been obtained in the practical working of them, the most careful and frequent attention is required to ascertain with accuracy the degrees of saltness which the water has acquired, and which, at its utmost, should not exceed twice that of sea-water. When, however, the vessel is stopped, or is working at reduced speed, the opportunity should not be neglected to change the water in the boilers by increased blowing off, and by an ample supply of feed-water, and thereby reduce its saltness *as much as possible.*

Such precautions as these, as well as never opening the safety-valves suddenly to their full extent, or, at starting, admitting the full quantity of steam to the engines, will always be necessary to keep a high-pressure tubular boiler in a proper state of preservation and in effective working order; but they are more especially necessary before experience has shown the exact practices which may safely be adopted; and, until such experience be obtained, the question of saving fuel, and all other considerations, must be regarded as of secondary importance.

The constant attention which will be required from the engineers in charge of the machinery of these vessels, and other circumstances, will, probably, at times, impose on them an unusual amount of labour and responsibility; but, as many of the boilers are precisely similar, the effect of judicious and careful management will be evident after a short time; and their Lordships will not fail to mark, with their approbation, those officers who have best performed their duty.

By command of their Lordships,
R. OSBORNE.

To all Commanders-in-Chief, Captains, Commanders, and Commanding Officers of Her Majesty's Ships and Vessels.

THE "ROYAL CHARTER,"

AUSTRALIAN AUXILIARY SCREW STEAMER.

THIS ship is called the *Royal Charter*, we understand, because the Company to whom she belongs received from Government a charter of limited liability.

Messrs. Gibbs, Bright, and Co., are the agents in Liverpool for this Company, and are sufficiently known to the engineering world as the successful developers of the capabilities of the *Great Britain*. The *Royal Charter* is intended to trade between Liverpool and Australia, and is fitted with an auxiliary propeller and a pair of direct-acting horizontal trunk engines, the main parts of which are disposed in the same manner as those of the engines of the *Arrogant*, the plates of which will be found in our Journal for May and June, 1850. From the dimensions which we shall afterwards give, it will be perceived that the propeller and engines are so proportioned as to justify the title "auxiliary" screw-steamer. They are not of that objectionable size, so often placed in screw-vessels, where the engine is considerably more than an occasional *assistance* to the progress of the ship, and yet of a power considerably less than would be safe to rely upon in case of immediate danger. How much the experience of late years has modified the views of the proprietors and constructors of steam-ships may be judged of, if we consider the power the *Great Britain* originally had to propel her, the power she now has, and, finally, the power the *Royal Charter* is provided with. Messrs. Gibbs, Bright, and Co., have ordered their engines

"Fine by degrees and beautifully less;"

for if we call the capacity of the cylinders in the *Royal Charter* 1, the *Great Britain's* present cylinders are in proportion as 1 to 8·8, and the first set bear the proportion of 1 to 20. We are told that the consumption of coal by Penn's engines in the *Great Britain* was 50 tons per day; with these direct-acting engines 15 tons will probably suffice to find steam for the same time.

The *Great Britain*.		The *Royal Charter*.	
Length for tonnage	289 feet.	Length for tonnage	320 feet.
Beam	51 „	Beam	42 „
Depth of hold	32·6 „	Depth of hold	26·6 „
Burthen	3,500 tons.	Burthen	3,000 tons.

The length between decks is nearly 330 ft. and the height is about 8 ft. 4 in.

The keel is 12 in. deep by 3½ in. thick; the garboard-strake is made of 1-in. plates, and her binding-strake of plates is ⅞-in. thick. The frames are 5 in. by 3⅝ in. thick, and the floorings are 2 ft. 3 in. deep. From end to end of the ship runs a box-kelson of unusual size and strength—in depth 2 ft. 9 in., in width 1 ft. 9 in.—to be used as a water-tank, and under the engines, as a store-room. Besides this main kelson there are two on each side, and there are also four watertight bulkheads. The vessel is of immense strength apparently, and a very liberal use of patent iron has been made in the beams, which spring from every other frame, these frames being very close together.

The poop cabin is 100 ft. long nearly, and there is, on each side of it, a range of state-rooms, 10 ft. by 6 ft., mostly fitted with double berths; the saloon is 7 ft. 6 in. high, and lighted with two spacious skylights, 18 ft. long by 8 ft. wide, the frames of which are made of teak.

We have been favoured, by Captain Martin, the marine superintendent of the Company, with some of the principal dimensions of the masts and yards. The fore-mast is 90 ft. long and 42 in. diameter; the main-mast is 95 ft. long by 42 in. diameter; and the mizen-mast is 84 ft. long by 32 in. diameter: she is new rigged with double topsail yards. The lower yards are 95 ft. long by 26 in. diameter; the lower topsail yards are 85 ft. by 20 in. diameter; the upper topsail yards, 76ft. by 18 in.; and the top-gallant yards, 56 ft. long by 14 in. diameter; the royal top-gallant yards are 42 ft. long by 11 in. diameter. The spread of canvass is 14,000 yards, at a displacement of 3,500 tons on 19 ft. draught of water. The area of the midship section is 605 ft.; the length of keel, 308 ft.; over all, 335 ft.; and the beam is 42 ft.

In our Journal for 1852 the dimensions of the spars and rigging of H.M.S. *Agamemnon* are given, and it will interest some of our readers to compare those dimensions with the foregoing; they will then fully understand how completely the *Royal Charter* merits classification as a "full-rigged" clipper ship. She is pierced for twenty guns, and will, when ready for sea, mount half that number. The guns she has on board at present are made by Fawcett, Preston, and Co., who made guns before they made marine-engines, fifty years ago, and are distinguished alike for both. They are short 18-pounders, though, if need be, the *Royal Charter* is strong enough to carry the heaviest guns. By Act of Parliament (we were informed by Captain Martin), or rather by measurement according to the Act, there is room for 640 passengers on the lower deck, forty-six being berthed in the state-rooms round the saloon in the poop cabin.

There is bunker room for 600 tons of coal; also, she can carry 450 tons of stores, 250 tons of water in tanks, and 2,000 tons of cargo. There are four absolutely watertight bulkheads, though three are only required by the Board of Trade; eleven pumps are fitted in connexion with the different compartments. There are also six life-boats and two ordinary boats, to be lowered in the ordinary way, Captain Boyce thinking that care, coolness, and courage will avail more in his ship than patents.

The engines of the *Royal Charter*, as we have before said, are nominally of 200 H.P., or about 1 H.P. for every square foot of midship section! or 1 H.P. for every 17½ tons burthen! With the help of steam sufficient confidence is felt in her sailing capabilities, as to lead the proprietors to expect her to make the passage to Australia in fifty-five days. The form of her engines must be familiar to all our readers, and they must also have noticed the care shown in balancing them, as in the *Himalaya*, &c. The expansion-link is also balanced, which relieves the engineer, in some measure, when starting. The throttle-valve is placed so as to check both engines simultaneously, and the injection-cocks are worked by levers and spindles closely adjoining the standard which supports the starting-shaft. With regard to the link motion, though, doubtless, it is very effective, we should prefer the direct "box-link." Theoretically and practically it is a better form than that used by Messrs. Penn. We do not see how, with a link of the type they have selected, a much better arrangement could be effected; but with a modification of the arrangement of the valve-chest and steam passages, the "box-link" might be introduced with advantage. Into the links of the *Royal Charter's* engines, as is now very commonly done, steel plates have been dovetailed, to take the wear of the block when in forward gear. As our readers are aware, the arrangement of these engines requires the discharge-pipe from the condensers to be carried to one side of the ship only, and the valve-box is of considerable size and weight. In this case, two wide wrought-iron straps have been passed round it and secured to the side of the ship, thereby taking much strain and weight off the joints and flanges. The bilge discharge-pipe terminates in a small valve-box, bolted to the side of the delivery valve-box. In the North most of the pipes are joined with bolts and flanges; but many of the pipes under 5 in. diameter, are jointed, in this ship, by chasing the lower part of the valve-box, and fitting a large nut on the pipe and screwing them together.

The cylinders are 50 in. diameter (less 21 in. trunk); stroke, 2 ft. 3 in., and the proposed number of revolutions, 75; the propeller being 14 ft. diameter, and 18 ft. pitch. From these figures it will be seen that the engines are rather smaller than some other makers call and sell as 200 H.P.; but that they are to run at a high speed, a fine-pitched screw, with small allowance made for slip being provided. We are strongly in favour of this arrangement, more especially when used as a means to propel large vessels.

The engines are placed forward of the boilers, between which the shaft passes; the boilers are fired fore and aft, and have twelve furnaces; the fire-bars are in two divisions, 3 ft. 6 in. long each; the tubes being 3 in. diameter outside, and 7 ft. long. A donkey-engine, made after Penn's well-known pattern, is fixed on light cast-iron brackets against the bunker. The funnel looks, comparatively with the masts and hull, rather like a stove-pipe, but is, however, 44 in. diameter.

Placed immediately aft the engine-frame is a pedestal and coupling, succeeded by the thrust-bearing, which is of the ordinary form, the collars being six in number. The collars are 10¼ in. diameter, and the shaft at this part 8¼ in.; the spaces for the shaft, in the brass, being nearly ⅝ in. wide, and the total length of brass 13⅝ in. The couplings are made of cast-iron, similar to the description shown in our September number (Prac. Paper, No. V., Fig. 4, p. 205), and fitted with six 2¼ in. bolts. The shafts are, in length, of from 18 to 24 ft., of a uniform diameter of 8 in., no allowance being made at the ends to compensate for the metal cut away by the pins and keys. The shaft-bearings are shorter than some we have seen by Penn; they are 1¼ times the diameter of the shaft in length. On the periphery of the coupling next to the thrust-bearing, a worm-wheel is cast, about 26 in. diameter, into which (vertically fixed by a suitable bracket) takes a worm 8 in. diameter, worked by a spindle and ratchet lever, by which the engines may be turned round by hand; this makes a very neat job, and is followed by the apparatus for drawing the shaft on board when the propeller is to be raised.

The propeller is fitted in a lifting-frame resembling the *Royal Albert's* in some particulars, and can be raised out of the water in about ten minutes; but the shaft in the stern-bush has a square end formed on it, fitting into a socket in the propeller-shaft, and ten minutes will be required to draw it back before the crew can begin to lift.

This is effected as follows:—A cast-iron cylindrical coupling, 3 ft. long, has a key, 17 in. wide by 2 in. thick, fitted into the middle of it, against each side of which abuts the end of a shaft. The shaft next the propeller is secured to the coupling by a strong round pin, and flat keys, to transmit the driving power, are fitted throughout the coupling. The forward thrust is taken through the wide cotter; the thrust, when the engines are reversed, on the plate fitted to the rudder-post. A groove is turned in the coupling, into which a collar, having two lugs formed upon it, is fitted, which collar is supported by a light wrought-iron frame running down to the main kelson. Through this lap two screwed bolts pass, and are secured to the feather on the pedestal adjoining this coupling. To draw in the shaft, the cotter in the centre is knocked out, ratchet levers fitted on to the square heads of the bolts where they project beyond the feather, and the bolts worked into the lugs of the collar, till the outer shaft is drawn up as far as the width of the key. We understand that this operation will take about ten minutes, besides the ten minutes required to raise the propeller.

The brasses in the frame for lifting the propeller are respectively 14½ in. diameter and 21½ in. long, and 10 in. diameter and 20¼ in. long, and have strips of boxwood, 2¼ in. wide on the face, dovetailed into them. These strips are ½ in. thick, and there are about three-quarter spaces between them.

So far back as 1823, in Tredgold's edition of "Buchanan's Essays on Mill Work," it is said that for pillow-blocks, "Boxwood and lignum vitæ were long in use. The latter has been found an improper substance for the purpose." We recently engraved a section of Penn's wood-bearings, fitted, however, with this "improper substance."

In concluding our notice, we must acknowledge the courtesy of Messrs. Gibbs, Bright, and Co., who, in allowing us to visit their ship, and in giving us introductions to Captain Martin, their marine superintendent, and Captain Boyce, her commander, afforded us the opportunity of laying the above particulars before our readers. The arrangements made by these gentlemen leave little room to doubt that the *Royal Charter* will fulfil all the expectations that the use of liberally supported skill and talent could raise or justify.

ISTHMUS OF SUEZ CANAL.

This important undertaking is, we with much pleasure see, progressing, and, as we think, soundly, under the judicious *handling* of M. Lesseps. That gentleman's highly-intelligent and effective *brochure* on the subject we noticed in our Number for October, therein showing a concise abstract of the able and clear analysis of the plan and intended works given by the Author, as also the course of operations proposed by him to immediately follow the important initiative, indeed, basis of operations—the Egyptian Viceroy's Firman of Concession.

In performance of those expressed intentions, and very accurate, business-like, and prompt it was, the following further steps have been taken by M. Lesseps.

The promised visit to this country and to France of the two engineers (the recognised *employés* of the Egyptian government), Mougel Bey and Linant Bey, has been made, and they have, in both countries, addressed themselves to the proper quarters.

The Commission of further survey has been not only formed, but actually assembled at Marseilles, has thence departed for the locality, and is, in all probability, at the moment of the present writing, engaged on the spot in investigations, intended, as may well be believed, to be most thorough and most faithful. How scientific and practical they are likely to be may be concluded from the powerful assemblage of scientific talent, and well-recognised engineering practice, known to be possessed by the bearers of the following important names, which cannot, however, be presented in better shape, or by more accurate description, than that of M. Lesseps himself, in a statement he has had occasion to transmit to this country on the subject. He says—

"The best mode of meeting objections and doubts which can, in this stage of proceedings, be presented by myself, as projector and *concessionaire*, is to point to the constitution, and approaching departure for Egypt, of the International Scientific Commission, which, according to the *instructions* of the Viceroy *himself*, is charged with his express mandate and authority to examine all the proposed plans, to minutely inspect the line of country and waters proposed to be operated on, and all adjacent parts, and then, with the greatest candour to resolve all the problems of science, of execution, and of art, which the operation presents or requires. Let the organisation of the Commission speak for itself; no terms of eulogy of mine, or of any other (says M. Lesseps), can enhance the estimate of the authorities composing it.

"Of England, the interests and science are represented by three persons:—

"Mr. Rendel, an engineer whose name is an authority;

"Mr. MacLean, another engineer, well-known in England by his hydraulic works;

"Commander Harry Hewet, of the Indian Navy, who has, for the last twenty-seven years, been engaged in hydrographic observations in the Red Sea and Indian Ocean.

"For France, the Commissioners are:—

"M. Renaud, Inspecteur-General des Ponts and Chaussées.

"M. Lieusson, Hydrographic Engineer of the Marine.

"For Italy:—

"M. Paleocapa, Engineer, and Minister of Public Works at Turin.

"For Holland :—
"The Chevalier Conrad, Engineer-in-Chief of Water-Staat.
"For Germany :—
"The Privy Counsellor Lentze, Engineer-in-Chief of Hydraulic Works of Russia.
"For Austria :—
"M. de Negrelli, Director of Public Works, nominated to the present Commission by the Imperial Minister of Finance, Baron Bruck."

With preliminary investigations sincerely made by such parties, there must surely be every prospect of safe progress. A course of testing so comprehensive, and by authorities bound by so much responsibility in both their own professional antecedents and their existing offices, has not often preceded any, even the greatest, undertakings. Much encouraged then do we feel to anticipate successful results from an enterprise, the conduct of which is initiated by so sound and candid a commencement. Assuming the report of this Commission to be broadly approbative of the plan, and to promise a satisfactory completion of the undertaking, we hope the next step will be a cordial international understanding between the Governments of Europe for not only permitting and promoting the formation of the canal, with its very desirable adjuncts, but, further, for effecting a treaty declaring it neutral ground and waters. As to the pecuniary means for carrying the project into effect, we understand that spontaneous offers by the *élite* of capitalists, to an amount more than sufficient for ensuring the success of the enterprise, have already been made to M. Lesseps, and that such have come to him from all parts of Europe.

For ourselves, we must say that, in well-wishing to this undertaking, we conceive we are also hallooing on that other enterprise of world-wide importance and deepest interest to the human family—the piercing the Isthmus of Central America. Most heartily do we wish that both interesting undertakings should be accomplished.

NOTES BY A PRACTICAL CHEMIST.

Oxide of Tin as a Polishing Powder.—M. Vogel prepares a solution of tin by pouring six parts of boiling distilled-water on one part of the commercial chloride. The solution is strained through a cloth into a glass vessel. A concentrated solution of oxalic acid is added to the liquid while still hot. When cold, the clear liquor is decanted, and the precipitate washed with cold water upon a linen cloth, until the rinsings no longer affect blue litmus. The oxalate thus obtained is dried and heated on an iron plate over a small charcoal fire. At a red heat decomposition commences; carbonic acid and carbonic oxide are given off, and peroxide of tin remains in a state of minute subdivision. During calcination the matter should be constantly stirred; and it increases very much in bulk. We obtain 1 lb. of oxide from 2 of chloride of tin and 1 lb. of oxalic acid. The oxide thus prepared is found admirable for polishing optical glasses, metals, &c.

Preparation of Colcothar (jewellers' rouge).—Sulphate of iron is dissolved in boiling water and filtered; concentrated solution of oxalic acid is added as long as a precipitate continues to be formed. When quite cold the liquid is filtered through linen, and washed on a cloth as long as the water shows an acid reaction. When partially dry, it is heated on an iron plate over a small fire. At 392° F. the decomposition commences; and on raising the temperature still higher, red oxide is formed in the finest possible state. This colcothar, without any washing, may be employed for polishing plate-glass, lenses, gold and silver, daguerreotype plates, concave mirrors for reflectors. By using this preparation the polishing of glasses may be greatly quickened.

Test for Coffee.—At the recent meeting of the British Association, Mr. J. Horsley calls attention to the use of bichromate of potash in analysing adulterated samples of coffee. With dilute solutions of pure coffee, this salt produces an intense deep porter-brown colouration, whilst upon decoctions of chicory no effect is produced. He advises the following procedure :—Take equal parts of chicory and coffee, and make separate decoctions in given quantities of water. Filter, bottle and label the liquids. Take a tea-spoonful of the chicory liquid and dilute till it be of a brown sherry colour; boil it in a porcelain dish with a fragment of crystallised bichrome. The colour will be scarcely deepened. If a similarly diluted solution of coffee is thus treated, we obtain a deep brown tinge. By operating with mixed liquids we may obtain a scale of colours indicating the proportions of the two substances. If a few grains of sulphate of copper be added, both decoctions yield a precipitate; that from chicory being a clay-yellow, and that from coffee a sepia-brown. Mixed decoctions yield, of course, intermediate tints.

[This test is highly valuable, and will serve to point out the presence of roasted wheat, beans, or similar matter, which, containing no tanno-gallic acid, cannot produce the deep colouration with bichrome. If, however, roasted acorns, or sawdust of woods containing tannin be present, the indication will become to a great degree fallacious.]

Valuation of Bleaching Powders.—M. Noellner takes 1 gramme of the chloride of lime or soda and places it in a small flask with 2 grammes of hyposulphite of soda and 10 to 15 grammes of water; the flask is closed, and well shaken. It is then placed for a short time on the sand-bath, and pure hydrochloric acid added to destroy the excess of hyposulphite. Free sulphurous acid is expelled by boiling, and the coagulated sulphur is filtered off. The filtrate mixed with the washings contains sulphuric acid corresponding to the chlorine. This is then either determined by a volumetric process, or precipitated with a salt of baryta and weighed.

116·5 parts, or one equivalent of sulphate of baryta, correspond to 71·5 parts, or two equivalents of chlorine. A good chloride of lime should yield sulphate of baryta to the amount of half its weight.

Molybdate of Lead as a Test for Phosphoric Acid.—This substance, in small quantity, is mixed with a little ammonia and an excess of muriatic acid. The fluid to be tested is then added and the whole boiled for a few minutes, when, if phosphoric acid be present, the characteristic yellow precipitate of phospho-molybdate of ammonia is speedily formed. Should sulphuretted hydrogen be present, it is first destroyed by boiling it with aqua regia.

ANSWERS TO CORRESPONDENTS.

"Argonauta."—The existence of gold in the Crimea appears, from a variety of considerations, decidedly probable, though we are without any data for determiuing the extent and value of the deposits.

"Querist."—Adulteration is not confined to food. A substance is now being sold to farmers as an ammoniacal compound, which contains 94 per cent. of common salt, and from which no ammoniacal vapours are disengaged by treatment with caustic potash or hydrate of lime.

AMERICAN NOTES.—No. XII.

Clipper Ship "Nightingale" (Illustrated by Plate 38).—The "Nautical Magazine" furnishes the following history and particulars of this celebrated clipper:—She was built in 1851, by Samuel Hanscom, at Portsmouth, for Capt. Miller and others, and designed for exhibition at the World's Fair at London. When she appeared in Boston Harbour, however, her symmetrical proportions and outlines attracted the attention of Messrs. Sampson and Tappan, enterprising merchants of that city, and they purchased her. She did not go to the Great Exhibition, as did the yacht *America*, but sailed on a voyage to Sydney, N. S. Wales, when she proved one of the very fastest sailers that ever ploughed salt-water. We have no doubt, that at the date of her construction, the *Nightingale* was the swiftest ship in the world; and even at this date, after so many larger clipper-ships have been built, her performances have seldom or never been excelled. In 1852, on her passage from Shanghae to London, she ran 336 nautical miles in the twenty-four hours; and the distance, 13,726 nautical miles, from Batavia Roads to London she accomplished in seventy days, being an average speed of 197 nautical miles per day, or 8·17 knots per hour, during a long voyage. In October, 1851, she sailed from Boston for Sydney, and arrived out in ninety-two days—the shortest passage made at that date. February, 1853, she sailed from Portsmouth, England, to Shanghae, and made the passage in 106 days. On a return voyage from Shanghae to London, February 16, 1855, the *Nightingale* passed Anjier in seventeen days, and arrived at London in ninety-one days sixteen hours.

She has never been beaten on a voyage by any vessel sailing about the same time: on the contrary, in 1852, she beat the British clipper-ship *Challenge*, from Shanghae to Deal, three days, having sailed but a few days after her English rival.

May 19, 1854, the *Nightingale* sailed from New York for Melbourne, and accomplished the shortest passage between these two ports ever yet made, viz., in seventy-six days and sixteen hours, notwithstanding she had light baffling winds on the first part of the voyage, and, consequently, was thirty and a half days to the Equator. But from the Equator to Hobson's Bay, the remaining portion of the voyage, the run was made in the unprecedented short space of forty-five days; her speed during this run frequently reached 14 and 16 knots. We shall give the abstract of her log on this voyage, as returned to Lieutenant Maury, at Washington. It will be found one of the finest examples of modern sailing anywhere extant; and we take pleasure in introducing her commander, Captain Mather, to our readers, not only in the capacity of an excellent navigator, but as a most able and accomplished shipmaster — the man for the ship.

The dimensions of the *Nightingale* are as follows:—Length on deck, 178 feet; breadth of beam, 36 feet; tonnage, 1,066 tons; depth of hold, 20 feet.

Her deadrise is very great, and she has an outstanding keel of 2½ feet. When in sailing trim, it will be seen she has a very large amount of natural resistance. Her aft end is very handsomely shaped, while we consider the bow, below light water draught, capable of improvement; it is a little too full near the stem, consequent upon an insufficient amount of hollow, so called, in the water-lines. The resistance on this vessel is greater at this point than at any other of equal area on the whole bottom. The *Nightingale* will require to be trimmed by the stern, to adjust her displacement, for the best sailing condition.

She carries about 1,000 tons of measurement goods, and is celebrated for her fine passages. She is tauntly sparred, with much rake to the masts, and has a very large proportion of sail for a vessel of her displacement.

It will not be out of place to remark, that she is regarded by her friends as the fastest and finest ship throughout the fleets of the world. Let it not be thought, however, that her great amount of deadrise has necessarily secured her a claim to superiority as a sailer, although it may be true that many of the finest performers on the ocean have been constructed upon this idea. It is equally true, that flat-bottomed ships, having fuller ends, and designed with a view to profit as well as speed, very often approximate the best work of the sharp-bottomed clipper. It is quite true, if too great a depth of hold and draught of water be chosen, a sharper model may be obtained by giving larger deadrise than by giving very little; but here its advantage ends, being nothing more than a compensation in shape at expense of cargo for ill-chosen dimensions. These remarks are general, and not made because we have been accustomed to modelling flat vessels, for we have now to acknowledge constructing several with too much deadrise though not exceeding 15 degrees from a horizontal line.

A New Shell.—It is stated that Professor Homer Anderson, late Professor of Natural Science at Clinton, U.S., has invented a new bomb-shell of terrible power. Professor Anderson claims that Sebastopol would fall before it; that it will wrap in flames any fortification of wood or stone, or, indeed, any city, however strongly fortified. A recent trial appears to have been very successful. One of the shells was thrown from a 6-pounder, by way of experiment, and falling upon some rocks, corruscations of light arose some 50 feet in the air, emanating from materials under the most intense ignition. It rained very hard, but, notwithstanding the rain, it burned on the rocks twenty-five minutes, and in various places on the grass, which was exceedingly wet. Cheers burst forth from the gazers when they saw the flames bursting forth on the rocks, covering an area of 20 square feet, before the sound of the cannon reached their ears, and that, too, with a miniature ball, whose weight when charged did not exceed 9 lbs. Professor Anderson intends to take his invention to Europe and sell it to the Allies, if he can.—[And, if not, to the Russians.—Ed.]

The Inventor.—This is the title of a new periodical that has just appeared in New York, designed for the perusal of mechanics and manufacturers; its first and second numbers indicate that it possesses the materials of usefulness and popularity. I copy, therefrom, in part, the following articles on the "New World," and "Anti-door Slam." That of the New World will give your readers a fair description of one of our river steamers.

The *New World*.—The latest wonder—the triumph in river steamers, is the *New World*; she is what might be called a three-decker, having the distinguishing quality of a third story, or second upper cabin; she is, in fact, a three-story floating Hudson River Hotel, beautifully proportioned and light, and so artistically constructed as to convey to the beholder a sense of security, fitness, and magnificence.

This steamer is magnificent in her appointments, capacity, strength, and speed. No passenger vessel is comparable to her. She has a length of 370 feet, 48 feet of beam (80 over all), and 10½ feet depth. Her engine has a cylinder, 76 inches in diameter, with a stroke of piston of 15 feet; her wheels are 46 feet, with a face of 11 feet.

With room to bed and board in voluptuous style 1,000 people, she can carry, in addition, upon her ample decks, 250 tons of freight. In good running order she can carry the passengers who throng her several stories at the rate of twenty miles an hour, and with this great speed those who read by her chandeliers will not experience interruption from the rattling of the glass drops, so firmly is she put together. Enormous as is her bulk, this vessel draws but 5½ feet of water.

We are embarrassed to choose a starting point for the details of her excellencies and capacities. But as sleep holds as high consequence now as when Sancho Panza invoked blessings upon the man who invented it, we will begin with the berths. Of those in state-rooms there are 540, 100 of which are open berths; altogether through the boat there are 800!

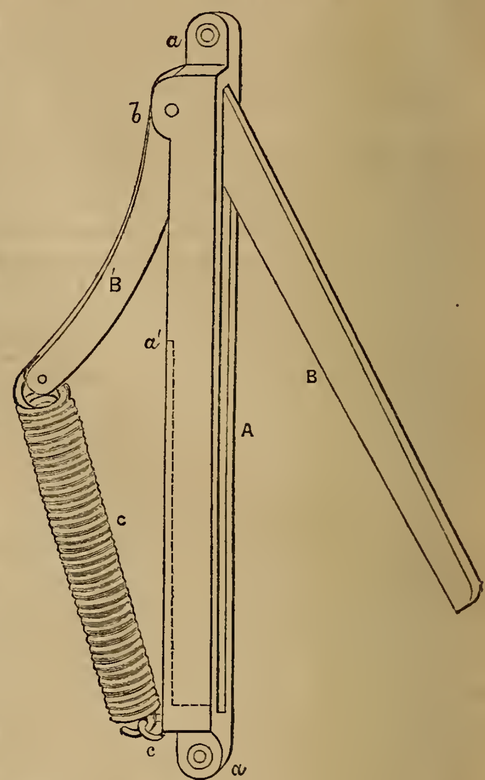
There are thirty-two family rooms, each containing three or more berths; there are four large club-rooms, and one elegant and roomy bridal cabin, the appointments and luxuries of which exceed all previous essays. Two large dressing-rooms, with all conveniences, have been provided for the ladies—one upon the main deck, and one upon the quarter-deck.

From keel to her sky-deck is 41½ feet. The airy and ample relations of the new upper saloon to the main one can be appreciated from the statement that the elegant ceiling of the former is 21 feet above the floor of the latter; that its forward gallery is 56 feet long by 21 feet wide, and its after gallery 85 feet by 28; while, below it, and connected with it by roomy stairways, the main saloon forward is 50 by 13, and aft 81 by 21.

The elegance and costliness of the lace curtains, the rosewood and gilt furniture, the marble, the cut glass and porcelain, the numerous oil paintings of great merit and greater interest, we shall pass by to pay our debt of thanks to Mr. Newton for his conscientious care for the safety of travellers, in so constructing this magnificent steamer, that lighted lamps and candles are not only unnecessary, but unattainable within the state-rooms. This element of danger is absent; the bedroom toilets can be made from the stationary lights in the main and upper saloons.

The *New World* is commanded by the veteran St. John—fit master for so noble a vessel. Take her all in all, we have never seen her like, and expect not to see her superior.

Anti-Door Slam. — Herewith is an ingenious and useful appliance or fixture for doors, the invention of Juan Pattison, of Brooklyn, N.Y. It has been given the name of Anti-Door Slam, its design being to prevent jarring when a door to which it is attached is hastily shut. Nervous people will appreciate it.



Letter A in the engraving indicates a metallic box, to be inserted into or placed upon the jamb of a door; B is an angular lever, upon the lower point of which the edge of the door touches in the act of closing; C is a spiral spring attached to the lever, and extending downward to the end of the box, C, keeping the lever at an angle with the door-frame, or jamb, while the door is open; *b* is a pin, attaching the lever, B, to the box, A, and upon which it acts; *a a* indicate the mode of fixing the appliance to the jambs of doors.

Western Steam-boat Statistics.—The number of steam-boats totally lost from January to July was thirty-nine. The estimated damage to boats was 573,700 dollars, and to cargoes, 1,229,800 dollars; thirty-one lives were lost; twelve steam-boats were destroyed by fire; seven were damaged by ice; fifty-two were sunk or damaged by snags; five were damaged by explosion; and seven by collision. The whole number of boats on western and south-western rivers is put down at 600. There has been no explosion or collapse of flue of any boiler manufactured since the passage of the law by Congress, August 30, 1852, and coming under the reduction of steam-pressure. In every instance the disasters have been from boilers made previous to the passing of that law.

Weissenborn's Patent Apparatus for Prevention of Incrustation in Steam-boilers.—This is the designation given to a novel arrangement for the purification of the feed-water for a steam-boiler from salts and soluble matter. The proprietors of the patent right in this country present the following description of it:—

"By this invention, all kinds of water can be used for steam purposes without any of the deleterious effects to the boilers which at present result from the use of impure water—all danger of explosion from the same cause is removed—a saving of from one-eighth to one-fourth the fuel effected (varying according to the impurity of the water), and a longer preservation of the boilers themselves secured.

"The principle of the invention is that of a filter through which the water passes, and in which all its mineral matter is deposited, from whence such matter can be easily removed without requiring any stoppage in the operations of the boiler.

"The operation of the apparatus is thus:—

"The water is fed to the apparatus from the well or cistern by means of a suitable pipe therefor, and upon entering the apparatus is met and commingles with a sufficient supply of exhaust steam from the boiler, introduced by means of another suitable pipe therefor, so as to become heated to about a boiling temperature, which, together with an ingenious arrangement of suitable material placed in the apparatus, causes the mineral or other impurities of the water to deposit thereon, and the water passes by means of another pipe into the boiler perfectly fresh and pure; so much so, that the same water which may scale the boilers at from one-quarter to one inch per month, can, by means of the apparatus, be used for a twelvemonth or longer without producing any incrustation in the boiler. This fact can be proved by a case where this apparatus has been used for over eighteen months, and where, during all that time there has been no incrustation in the boiler, although using water which, previous to the use of this apparatus, would incrust the boiler about half an inch every three or four weeks.

"I beg to refer to the subjoined certificate of the use and efficiency of the apparatus at Mr. William Burdon's steam-engine manufactory, Brooklyn, N. Y.

"'Brooklyn, June 16th, 1855.

"'I hereby certify, that I have used one of Weissenborn's Patent Apparatus for the Prevention of Incrustation in Steam-boilers for the last *five months*, and would say that I am perfectly satisfied with its operations. *I believe it is the only machinery yet invented that will entirely separate lime and other impurities from water when using hard water.* Heretofore I have had to clean out my boilers every *three* or *four* weeks, when the scale which had collected therein would be from ⅛th to ⅜ths of an inch thick; but since I have used Weissenborn's Apparatus, I have not seen any kind of incrustation in the boilers, as all sediment has been retained in the machine.

(Signed) "'Wm. Burdon,
"'Steam Engine Manufacturer,
"'102, Front-street, Brooklyn, New York.'"

The utility of this instrument is further vouched for, and it is about to be tested in a conclusive manner. I can recognise the features of practicability in it; and if this opinion should be verified, the invention will prove a valuable one.

H.

DESCRIPTION OF A NEW MOULDING-MACHINE FOR COG AND OTHER WHEELS.*

BY MR. PETER ROTHWELL JACKSON.

The difficulty that the writer experienced in the course of his practice, in not being able to find wheels for driving machinery exactly suited in form, strength, and speed to the purposes required—(a difficulty that has been extensively felt, notwithstanding the very large and costly stock of wheel-patterns existing in this country)—led him some years since to investigate the subject, with a view to discover if some mode of construction could be adopted which would enable the founder to make cog-wheels from a simple segment of two, three, or more teeth of any diameter, pitch, breadth, or shape of tooth, without the use of a pattern in the ordinary way.

The result is the machine, a description of which is the subject of the present paper.

The process hitherto adopted for making the best cog-wheels, whether spur or bevel wheels, has been to construct an entire pattern of wood, an exact *fac-simile* of the wheel to be cast, having each tooth formed and shaped upon it with great care. In all cases this involves a considerable expense and time, besides requiring very careful stowage till the pattern is next needed; but in the case of large wheels this becomes a serious consideration, particularly the time required for preparing the pattern, which causes a great addition to the loss and inconvenience occasioned when an accident happens to one of the wheels in a factory, thereby stopping a large portion of the machinery.

It will be seen that the plan now submitted enables the founder to produce wheels in the shortest possible time, and with a degree of accuracy which is quite unattainable in the usual way, in which patterns are often made in a hurry of imperfectly-seasoned timber, and are rarely true even for a short time; and, unless made from timber that has had years to season, constructed with the greatest care, and carefully stored, soon become valueless altogether.

The proper form of teeth, which in every case should depend upon the dimensions of both the wheels which are to work together, can seldom be obtained in the ordinary way, owing to the great expense of good patterns. This often leads to the adoption of a form of tooth which is but an approximation to that degree of truth which is readily attainable by the plan now submitted.

It has often been found that wheels of the same pitch, and breadth, but from different makers, will on this account not work well together; this difficulty has sometimes been got over by a hand process of chipping and filing (commonly termed pitching and trimming), but such a process, besides the great objection in regard to expense, involves the accuracy inevitably attaching to hand work, and has also the objection of removing the hardest and best portion of the metal.

The nearest approach to accurate construction in this direction was, the writer believes, the attempt (formerly made by Mr. Brunton, of Soho) to shape the teeth by a slotting-machine, the tool of which was guided by a templet of the desired tooth.

To obviate the difficulties that have been referred to, the writer conceived the idea of placing in the foundry a machine, on the principle shown in the drawing, by which, as will be seen, he is enabled to produce with great accuracy a short segment of pattern, and also to mould with equal accuracy, from the segment thus produced, the entire circumference of the wheel required.

Fig. 1, Plate [illegible], is a vertical elevation of the machine, showing the moulding-box and apparatus connected with it, partly in section; Fig. 2 is a plan of the machine; Fig. 3, vertical section of table and moulding-box; Fig. 4, sectional plan at x x.

The machine consists of a vertical spindle, A, with a circular horizontal table or face-plate, B, upon it; this spindle works in the conical bearing formed in the centre of the frame, C.

The foot of the spindle, A, is supported by four diagonal struts, D D, extending downwards from the frame, C, which support the weight of the table, B, and anything that may be put upon it, by means of a footstep, E, by which the table can be raised at pleasure in the conical bearing in the upper frame, C, thereby enabling the workman to turn the table round with very little force and perfect steadiness, though bearing great weight upon it.

F F in the elevation and plan is a horizontal slide-bed, attached firmly to one side of the frame, C; upon this slide is moved the sliding jib, G, carrying at its extremity the vertical slide, H, a side elevation of which is shown in Fig. 2.

A rack, I I, is attached to the slide-bed, into which works a pinion on the shaft, J, driven by bevel-wheels and the cross handle, K. By means of this apparatus the vertical slide, H, can be placed in any position that may be required over the table, B, or may be removed entirely clear from it on either side.

The set screws, L L, are for the purpose of fixing the sliding-jib firmly upon the bed, and holding it in any position that may be required.

The vertical slide, H, is moved by a rack and pinion, worked by a handle and shaft, M, and is rather more than counterpoised by a weight, T, attached to a chain passing over a pulley at the top. A ratchet-wheel with pall, shown in Figs. 5 and 6, is fixed upon the handle, M, to hold the slide from being drawn up by the balance-weight, or forced up by the moulder; and the balance-weight is made a little in excess so as to insure a pressure always upwards against the pall of the ratchet.

On the lower end of the slide, H, the block of wood out of which the pattern of the teeth is intended to be produced, is fixed by being first screwed to a metal plate, which is bolted to the slide, H, being fitted to the plate with vertical and horizontal guides, and having corresponding ribs let into the pattern-block to hold it perfectly steady during the subsequent operations of cutting and moulding, and also affording the means of fixing the pattern true and square upon the plate on any subsequent occasions.

The worm-wheel, N, is fixed on the under side of the circular table, B, and is moved by the worm and shaft, O, which shaft is turned round by the handle and change-wheels, P, similar to an ordinary dividing or wheel-cutting machine.

The worm and worm-wheel are constructed with great accuracy, and are protected from injury and exposure to any dust of the foundry by a water-lute, V, consisting of a vertical ring cast upon the under side of the table, and revolving in a small circular trough of water attached to the plate of the lower frame.

By turning the handle, P, the required number of times, having previously adjusted the change-wheels so as to suit the number of teeth in the wheel intended to be moulded, the circular table, B, is turned round an interval equal to the pitch of the wheel, and this movement can be accurately repeated in succession through any portion of the circumference.

A block of wood, R, having been fixed upon the slide, H, the slide being adjusted at the required distance from the centre of the table, and the change-wheels having been arranged to suit the required number of teeth, a cutter (of which a specimen is exhibited) is fixed in a horizontal spindle, which revolves in a stand fixed upon the main table, B, at the correct distance from the centre of the table corresponding to the radius of the intended wheel. This cutter is made to revolve rapidly, and the pattern-block is then moved down gradually by the vertical slide, H, until a parallel cut is obtained through the entire block, forming one space in the pattern. The block is then raised, and by turning the table round the distance of the pitch, and repeating the cut by passing the slide down again before the cutter, another space is formed; which operation is repeated until all the required spaces are cut in the segment pattern. A specimen of the segment is exhibited, corresponding to the cutter and block previously shown.

The pattern is made to terminate at somewhat less than half a tooth on each side, and a thin metal shield is fixed on each end in the direction of a radius of the circle, projecting about an inch beyond the crown or point of the tooth, for the purpose of preventing the moulder, in the subsequent process of moulding, from disturbing the teeth that he has previously formed in the sand. The formation of the short segment pattern, R, being completed, the cutter and stand are removed, and the moulding-box, S, placed on the table.

In the conical hole in the centre of the table is fitted a bush, in which an upright spindle works, the purpose being for measuring from it the diameter of the wheel, and for strickling or levelling the sand in the moulding-box, S, to form the bottom of the mould of the intended wheel, previous to commencing the moulding of the teeth.

The moulding of the teeth is performed in the following manner:—The segment pattern, R, is brought down by the slide, H, until it rests upon the levelled sand forming the bottom of the mould, the top of the

* Read before the Institution of Mechanical Engineers, Birmingham, April 25, 1855.

+61

segment being level with the edge of the box, and it is there held by the ratchet and pall, and weight.

The moulder then rams up in the ordinary way that portion of the box opposite the segment pattern, and after venting the teeth, removing the pall, he draws the pattern by means of the rack and pinion of the slide, H; he then turns the table round by the handle, P, through the interval equal to the number of teeth contained in the segment pattern. The pattern is then again lowered, and the ramming up of the mould repeated in the fresh position of the box, and the same process continued until the entire circumference of the wheel is moulded.

In sliding down the pattern into each fresh position, it is prevented from disturbing any portion previously moulded, by its not actually touching the sand, and the shield-plates on each end of the pattern prevent any risk of injury in the process of ramming. These plates leave a narrow channel in the sand, causing a small fin on the centre of the crown of the tooth at that position, which is broken and chipped off by the dresser after casting.

The moulding of the cogs (the essential part of the mould) being thus completed, the box can be removed from the machine, and the moulder can proceed with another wheel, whilst other hands place the cores in the mould already formed. The spaces between these cores form the arms of the wheel, and the centre of the wheel is cored out in the ordinary way; the rim of the wheel is formed by the spaces left between the outer extremities of the cores and the sand forming the teeth, and the boss or nave is formed by the space between the centre core and the inner ends of the cores.

The top box, having the lower edge turned, is rammed up on a true surface-plate, forming simply a flat top to the mould, and when placed upon the bottom box, the upper edge of which is also turned, and is on a level with the upper surface of the intended wheel, the sand being strickled off to the edge, forms a perfect joint; and with the cores before named completes the mould for the wheel.

Bevelled wheels are made by the same system on the machine, from a short bevel segment pattern, to produce which a peculiar cutter-stand is used, admitting of adjustment to any desired bevel, by which, and the machine, the operator is enabled to impart a correct spacing, and very nearly complete the entire segment. The pattern for a bevelled wheel is lifted vertically out of the sand in the same direction as a spur-wheel, and does not slide in the direction of the inclined teeth, on account of the tapered form of the teeth.

Racks can also be made by this machine from a few cogs, by attaching a dividing screw and change-wheels to move the sliding-jib and vertical slide, H, and fixing the pattern-block at right angles to the face of the slide by an angle bracket, so as to mould the rack in a line parallel with the slide-bed.

For moulding very large wheels extending beyond the range of the apparatus, the sliding-jib and carriage are removed altogether, and a horizontal arm fixed on the revolving table, carrying at its outer extremity the vertical slide, H, and the segment pattern, which are then moved round by the dividing gear, instead of moving the moulding-box, the operation of moulding taking place in a circle round the machine. The cutter-stand for cutting the pattern in this case is fixed upon the ground at the proper distance from the centre of the machine, and the pattern is made to move past the cutter, instead of the cutter moving from space to space of the pattern as before.

The following advantages are experienced in moulding by this machine:—Each wheel being made from a pattern of its own, specially adapted to work into its fellow, and not with reference to any other wheel, the general principle that *any two wheels should have the particular form of teeth that will work best together* can be strictly carried out without difficulty, and at a trifling cost.

The accuracy which has hitherto been with difficulty obtained, even in the best patterns, is by this machine strictly imparted to the sand itself. The teeth, however long or broad, can, by means of the slide, H, be drawn out of the mould without any taper allowance whatever, and the workman's attention being directed to a few teeth only at a time, he is more likely to give them special care. The time not unfrequently spent in what is called mending the mould, but which in fact, from the difficulty of guiding the hand, is too often found to impair the correctness of the work, is thus saved.

The result is the production of spur and bevel gear of so much greater accuracy than has been produced by other means, that they can be run at a higher speed than has been hitherto considered advisable in heavy gearing.

There is also less need for mortice-wheels, as the noise of gearing proceeds principally from too much clearance, and the want of truth in the teeth.

This plan of moulding allows of H spokes, with flanches round the inner edge of the rim, being adopted, as readily as the ordinary -|- or T section of spoke; the H spoke makes a stronger wheel, but is not easily obtained by the old system.

Spur-wheels, with shields or flanges to the crown or pitch line, are made with greater facility than by the ordinary process of moulding, as the lower shields are more easily withdrawn, owing to the absence of sand in the centre of the mould.

The large, and, in some cases, valuable fire-proof buildings, erected for the stowage of wheel patterns, will, by the adoption of this process, be saved, as one machine gives a greater range of pattern than the largest stock contains.

This method is useful in enabling the founder to match exactly any old wheel, whether the same have parallel or taper teeth, by forming a short segment pattern to work with it with the greatest correctness practicable, and without having to adapt or modify any previous pattern.

It may also be observed that the breakage of a wheel generally implies a deficiency in strength for the work it has to do, but with the old pattern the strength cannot well be increased.

In order to show in how short a time a wheel can be produced by this process, an instance may be mentioned of a spur-wheel, for which the following order was sent to the author, by telegraph, from Bristol, on 1st December, last:—

"One spur-wheel, twenty-eight cogs, two feet three diameter at pitch line, cogs two and a quarter long, eight inch broad, six and five-eighths round eye, cast, four arms. Send by rail immediately. Write."

This order was received at the writer's works at a quarter past three o'clock in the afternoon; the tin templet, steel cutter, and segment to the right size, pitch, and number of cogs, were produced; the wheel was moulded and cast, weighing 6½ cwt.; and after remaining five hours in the sand was taken out and dressed, carted nearly two miles, and forwarded by the Bristol train, which left Manchester at half-past nine o'clock the following morning, being a total time of eighteen and a quarter hours; thirteen hours being the actual time of making the wheel.

ON AN IMPROVED PRESSURE-GAUGE FOR STEAM AND WATER.*

By Mr. John E. Clift, of Birmingham.

The pressure-gauge, which is the subject of the present communication, is the invention of Mr. James Webster, of Birmingham, and appears to possess some practical advantages deserving of notice.

The gauge acts upon the principle of a circular elastic plate receiving the pressure on one side, the plate being fixed round the circumference, and registering the amount of pressure by the extent to which it is displaced or bulged in the centre. The extent of motion of the plate is multiplied by a simple contrivance, and communicated to an index, which shows the amount of pressure by its revolution round a dial.

The pressure-gauge differs from others acting upon the same principle, mainly in the increase of the area of the plate upon which the pressure acts and in the mode of multiplying the motion, which appears to possess some advantages in simplicity, directness of action, and durability of the parts.

The construction of the gauge is shown in the accompanying drawing: specimens are also exhibited of the different forms of the gauges, complete, and with the outer case removed to show the interior.

Fig. 1 is a longitudinal section of the gauge, half full size.

A is the pressure-plate, consisting of a circular flat plate of tempered spring steel, No. 18 wire gauge, or about 1-20th inch thickness, and 4 inches clear diameter, or 12½ square inches area, in the central unsupported portion upon which the pressure that has to be measured acts.

This plate is fixed in a circular cast-iron frame, B C, by screws round the circumference, which press the outer ring, C, upon the plate, and make a tight joint at the back of the plate by means of a thin washer of vulcanised india-rubber.

The back part, B, of the case has a shallow recess, 4 inches diameter, communicating by a channel, D, with the stop-cock, E, at the bottom of the gauge; and this recess becomes filled with water, from condensation of the steam, when employed to measure steam-pressure, and always remains full of water on account of the channel, D, entering at the top of the recess, thus preventing the direct contact of the steam with the pressure-plate, A.

A small steel stud, F, is fixed in the centre of the plate, A, by a screw and nut, and is formed with a knife-edge bearing at the top, pressing against the back of the lever, G; this is centred on a bracket, H, at one end, and presses upon a second lever, I, by a knife-edge bearing at the other end.

The sliding-bracket, H, on which the lever, G, is centred, is fixed by a screw upon the ring, C, and has an adjustment by a slot, by means of which the length of the short end of the lever, from the point of contact of the centre stud, F, can be increased or diminished, as may be required.

The lever, I, terminates in a fork, which works up and down the spiral, L, upon the extremity of which is fixed the index revolving on the face of the dial.

* Paper read before the Institution of Mechanical Engineers, Birmingham, July 25, 1855.

The fork at the end of the lever, I, is shown detached in Fig. 2, and is made of two tapered steel rods which enclose the spiral, L, and press lightly against it by their elasticity; the ends of the rods being steadied by a small clip joining them together.

WEBSTER'S GAUGE.

Fig. 1.

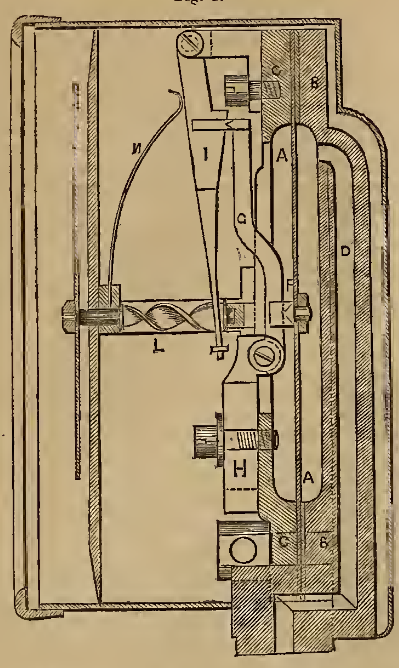


Fig. 2.

The spiral, L, makes one turn only in its whole length, and is gradually tapered and shortened in the pitch towards the outer end, so as to adapt it to the motion of the levers, and give a uniform division for the successive pressures indicated upon the dial.

When the pressure is admitted to act upon the back of the steel-plate, A, the plate becomes convex, rising in the centre and pressing by the knife-edge stud, F, upon the lever G, which multiplies the motion four times; and this, pressing on the second lever, I, again multiplies the motion four times (being 16 times total) at the end of the fork acting on the spiral, L. This fork, in traversing the length of the spiral, 1⅛th inch, turns the index entirely round the dial, in a circle of 16 inches circumference. The total amount that the pressure-plate is raised or bulged to produce this motion of 16 inches is 1-16th of 1⅛th inch (the latter being the motion of the forked end of the second lever), amounting to 1-14th inch at the centre of the plate, or ·07 inch.

When the pressure is removed, the plate returns to its original position, and becomes again quite flat, and the levers are retained in close contact throughout by the spring, M, pressing on the second lever, I, and bringing the index back to zero.

In this pressure-gauge the working parts are all of comparatively large size, having consequently an advantage in strength and durability; they have also great simplicity in construction and action, and appear very free from liability to derangement or accident.

The pressure-plate, A, consists of a simple flat disc; and this form is considered by the inventor, from the results of his experiments, to have a practical advantage over corrugated plates, which have also been extensively used for the same purpose, on account of the uniformity with which the flat plates can be tempered, whilst the corrugated plates are liable to have an inequality in the tempering, the more exposed portions at the tops of the corrugations being liable to be softer than the intermediate portions.

To meet the unavoidable variation in the tempering and resistance of the steel plates, even when plain flat plates are used, the position of the fulcrum of the first lever, G, is shifted by moving the sliding bracket, H, by means of which the range of the instrument can be readily adjusted. Each gauge is separately adjusted in this way, by the application of actual pressure, so as to ensure accuracy of the indication in each case.

The steel plates are all capable of standing more than double the pressure indicated by the extreme range of the dial, without receiving any permanent set; and it appears, from an extensive series of trials made by the inventor, that no perceptible change of elasticity is produced by long exposure to alterations of pressure and continued pressure within the limit.

A different thickness of plate is employed for gauges having different ranges of pressure, the area of plate exposed to the pressure being the same in all cases—namely, 12½ square inches.

No. 18 wire gauge, or about 1-20th inch thickness, is employed for pressure-gauges extending to 200 lbs. per square inch.

No. 20 wire gauge, or about 1-30th inch thickness, for 60 lbs. per square inch.

No. 23 wire gauge, or about 1-40th inch thickness, for 20 lbs. per square inch.

The extreme deflection of the plate in each case is only about ·07 inch, or little more than 1-16th inch.

The following results have been obtained by trial of the plates under successive pressures by a hydraulic press, the pressure being measured by weights upon a lever multiplying four times:—

Thickness.	Pressure.	Deflection.	Set.
18. Wire Gauge.	0 lbs. per square in.	·00 ins.	—
	50 „	·03 „	—
	100 „	·05 „	—
	150 „	·06 „	—
	200 „	·07 „	—
	300 „	·09 „	—
	400 „	·10 „	—
	500 „	·11 „	—
	600 „	·12 „	No Set.
20. Wire Gauge.	0 „	·00 „	—
	50 „	·03 „	—
	100 „	·05 „	—
	150 „	·07 „	—
	200 „	·09 „	No Set.
	800 „		·08 Set.
23. Wire Gauge.	0 „	·00 „	—
	10 „	·02 „	—
	20 „	·03 „	—
	50 „	·08 „	No Set.

A modification of this pressure-gauge is shown in Figs. 5, 6 and 7, Plate 22, and the specimens exhibited, in which a spring is employed to measure the pressure at the end of a safety-valve lever, as in an ordinary spring-balance, and the indication is multiplied by means of the spiral, L, without the intervention of any lever. The spiral is moved by the forked rod, I, and the motion is communicated to the revolving index by the bevelled pinions, O.

A considerably stronger spring than usual is employed in this case, having only 1¼ inch extent of motion, which is multiplied to a circumference of 12 inches upon the dial.

The advantage aimed at in this balance is, that the spring does not require to be extended so much as in the ordinary balance, owing to the introduction of the multiplying spiral, and, consequently, the steel being less strained, is less liable to a permanent set in the course of long work; also, the indications of pressure are rendered more plainly visible by the motion of the index upon the dial.

Another adaptation of the spiral is shown in Figs. 8 and 9, Plate 22, and specimen exhibited, where the spiral is applied to the indication of the level of the water in a boiler or a tank.

A hollow copper float, P, lies upon the water, the lever of which is attached to a forked lever, I, at right angles to it, which works upon the spiral, L; and as the float sinks with the water, the lever, I, acting upon the spiral, L, causes the index to revolve upon the dial.

The forked end of the lever, I, working loosely upon the spiral, and the continual motion of the water in the boiler keeping the float and spiral in constant action, prevent any tendency to stick fast; and the friction is confined to the small conical collar on the spindle of the spiral passing through the side of the boiler, by means of which the joint is kept tight by the internal pressure.

This water-gauge has an advantage over the ordinary glass gauge in the indication being always readily seen, as when the water becomes muddy or the glass soiled the level is not so easily ascertained in the tube; also, by enlarging the diameter of the dial, each inch of variation in the level of the water in the boiler can be magnified to two inches, or more if desirable.

A specimen of the pressure-gauge was exhibited, and put in action by means of a force-pump; also, specimens showing the construction of the gauges, and the steel plates that had been experimented upon.

The CHAIRMAN remarked that he had tried the improved spring-balance that had been described, and it was certainly more plainly visible in the indications of pressure than the ordinary Salter's spring-balance, but he did not see that it was superior in accuracy or durability of the spring; he had had balances of Salter's indicating up to 180 lbs., and they were not found to get set.

Mr. CLIFT considered Salter's balance was liable to get out of order, owing to the extent to which the spring was stretched, which caused it to be liable to be sometimes strained, and, consequently, rendered inaccurate; he thought the small extent of motion in the improved spring-balance would prevent the spring from getting set at all.

The CHAIRMAN did not think too great an extent of motion was allowed to the spring in Salter's balance, as he had not found any cases of these balances becoming set and thrown out of adjustment, even after being a long time in use; the springs were very excellently tempered, and the least likely to get out of order of any that he had tried.

Mr. JOY observed that range of indication was not the only requisite in a spring-balance, but also range of lift for the valve itself, to give free relief to the steam blowing off; if the range were shortened there would not be sufficient area of escape for the surplus steam, and the pressure would rise considerably beyond the limit intended to be used. He had known the pressure rise 25 lbs. during blowing off, and in one case where $2\frac{1}{2}$ inches range of spring had been allowed for a limit of 120 lbs. pressure, the increase had been 20 lbs. during the blowing off.

Mr. Webster remarked that the dial might be adapted to any range of spring that might be required, by simply increasing the pitch of the multiplying spiral.

Mr. Hodge thought that the Diaphragm pressure-gauges, registering by the deflection of a circular steel plate, such as Schaeffer's and the one described in the paper were quite equal to any in use; the arrangement in Mr. Webster's gauge appeared very good, and had some decided advantages over the other kinds of gauges in use.

Mr. Webster observed that the principal feature in his own gauge was the use of a larger and stronger diaphragm, in consequence of which the extent of motion and strain upon the particles of the plate was so much diminished, that the risk of permanent set by constant use was prevented.

The Chairman asked to what extent the steel plates were tempered?

Mr. Webster replied that they were first hardened, and then tempered down to just below a straw colour, so that the file would just touch them; the gauge was then adjusted to the elasticity of the plate, by means of the moveable slot carrying the end of the first multiplying lever. All the plates were proved by a hydraulic press up to double the pressure they were required to register.

Mr. Shipton inquired whether the india-rubber cloth at the back of the plate, being an elastic material, was not found to yield after wear, and affect the fixing and adjustment of the pressure-plate: and he asked whether the gauge had been tested by continual exposure to high-pressure steam for a considerable time.

Mr. Webster stated that the india-rubber cloth was used only for the joint at the back of the pressure-plate; tin and lead had been tried, but the cloth was found to be preferable, and either a complete disc or an annular ring was employed. The cloth got fully stretched during the testing of the plate, and so did not yield any more afterwards; the thickness in the joint was so small that it could not alter. Each gauge was tried, when made, by subjecting it repeatedly to a pressure double of that at which it was intended to be worked, which would thoroughly bring all the parts to a bearing. He had tried a gauge under a constant water-pressure of 150 lbs. per inch for three days successively, but did not find any yielding of the india-rubber joint.

Mr. Rofe inquired whether the india-rubber cloth was not liable to get burnt by the high temperature of the steam.

Mr. Webster replied that in consequence of the back of the gauge being always kept full of water, by means of the syphon passage for the admission of the steam, the pressure-plate was always protected from contact with the steam, and consequently remained cool, so that the cloth was not injured.

The Chairman remarked that the present pressure-gauges were sometimes found to lose their elasticity, and inquired whether this was not the case also with Mr. Webster's.

Mr. Webster answered, that when the plates were made of proper thickness, suitable to the pressure required, and well-tempered, they retained their elasticity, and exhibited no tendency to a permanent set after long-continued use. The plate exhibited, which had a permanent set of ·08 inch, had been made of too thin metal; and that which was burst had been tempered too hard. The tempering of the plates required great accuracy and certainty in pressure-gauges, and this could be more perfectly accomplished with the thicker plain plates that he employed, than with the thinner corrugated plates, which he had found liable to be rather softer at the tops of the corrugations than at the intermediate portions. The thinner plates were also more liable to set than the thicker ones, and by using the plates of No. 18 wire gauge the tendency to a permanent set was entirely removed.

Mr. Hodge stated that the Russian engineers appeared to be in favour of diaphragm-gauges, as circular steel plates had been adopted for the Government pressure-gauges; the plates were of large size, he believed 9 or 10 inches diameter.

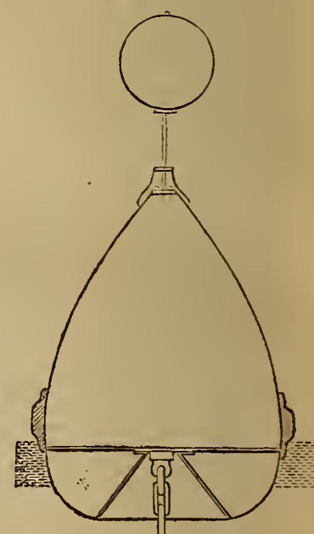
Mr. Clift remarked, that in Schaeffer's pressure-gauge, the disc, of about 24 wire gauge, was corrugated in circular corrugations, but in the one described in the paper, the disc was flat and about three times the area. The flat discs could be tempered uniformly throughout, and he had been struck with the perfection with which they retained their elasticity in the several severe trials. He mentioned that the pressure-gauges were being manufactured by Messrs. Gray and Bailey, of Birmingham.

The Chairman observed that the uniform temper of the elastic plate was a point of great importance for ensuring permanent accuracy, and he thought this advantage, and the simplicity of its construction, rendered the gauge a very serviceable instrument. He proposed a vote of thanks to Mr. Clift for the paper, and to Mr. Webster for his specimens, which was passed.

ON THE CONSTRUCTION OF BUOYS, BEACONS, AND OTHER STATIONARY FLOATING BODIES.*

By Mr. G. Herbert.

Floating sea marks, as ordinarily constructed, were, it was stated, admitted to possess the defect of riding uneasily on the waves, under which they were frequently buried, so as to be scarcely visible when most required; besides which, it was not an uncommon circumstance, in heavy weather, to find that a buoy had broken its chain and floated away. The present form of the buoys, and the fact of the mooring-chains being attached to a point far below the centre of gravity, sufficiently accounted for these and other acknowledged defects, and induced the proposition of a form of stationary floating body, which should have a tendency to ride easily, and to retain its perpendicularity, whilst the point of attachment of the mooring-chain would be in such a situation as to subject it to the least amount of strain, and not be liable to draw the buoy down into the trough of the waves. With this view a wrought-iron pear-shaped buoy was constructed, of a circular form in plan, and terminating above in an apex, so distributing the weight, as that the centre of gravity should be situated a little below the centre of the plane of floatation, and the bottom was made concave, and raised up internally, so as to form a cone, to the internal apex of which the mooring-chain was attached.



Herbert's Buoy.

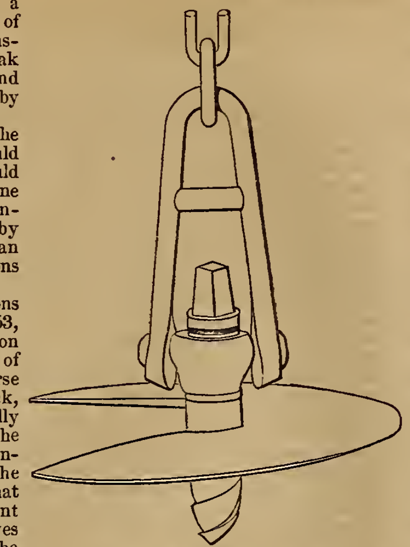
This form was found so completely to answer the purpose that several buoys were made by Messrs. Brown, Lennox, and Co., for the Corporation of the Trinity House, and were pronounced to be superior to any previously built. A buoy of 9 ft. in height, 6 ft. 6 in. diameter, and having only 2 ft. of the body submerged, exhibited, under all circumstances of wind and tide, an upright body of 7 ft. out of the water. This quality of retaining its vertical position arose from the force of the tide or wave being simultaneously exerted upon one side of the exterior of the buoy, and on the opposite side of the interior cone; the forces so nearly balancing each other as to retain the floating body in an almost perpendicular position.

Encouraged by the success of the first experiments, the Trinity House authorised the construction of a wrought-iron Sea Beacon on the same principle. The floating base was 20 ft. in diameter, divided by radiating bulk-heads into six watertight compartments; it drew 4 ft. 6 in. water, and supported a tower, also of wrought-iron, 28 ft. high, 7 ft. diameter at the base, and 3 ft. 6 in. diameter at the top, surmounted by an iron ball of the same diameter. This beacon was moored in the over-fall of the sea, at the South Sand Head of the Goodwin Sands, and was admitted to have been the best and most conspicuous sea-mark ever laid down. During very heavy storms it was observed that the greatest angle assumed by the tower did not exceed 10° from the perpendicular, without any tendency towards circular motion. When it had been afloat for about five weeks, it was observed to sink gradually during very moderate weather, evidently from having sprung a leak. It was conjectured that this casualty arose from the mooring-chain having been improperly fixed in the hawse-pipe of the cone, instead of being below it, and thus that the links were brought into contact with the plates of the compartments, which, being only $\frac{3}{8}$ths-inch in thickness, were soon chafed through, probably in several places simultaneously, and the several compartments becoming filled with water, the beacon was submerged. The recurrence of such casualties in similar structures could, in future, be easily remedied, by attaching the mooring to the proper point in the cone, as is done in the buoys, and thus guard against the possibility of any friction against the body of the watertight compartments.

It was now proposed to carry out this principle of construction upon a larger scale, and to erect upon the floating base, a tower sufficiently large to serve as a substitute for a lighthouse. A plan for such a structure, as submitted to the Trinity House by Sir Charles Fox, was described. The floating base was 80 ft. in diameter, and drew 20 ft. water; the tower was 130 ft. high, 24 ft. in diameter at the base, and 14 ft. at the lantern; the weight of the tower and lantern was 117 tons; and the total displacement of the whole building was 1,602 tons; the centre of gravity being 2 ft. 6 in. below the surface of the water. The weight of a double mooring-chain, the links of which were $3\frac{1}{4}$ in. diameter, would be about 46 tons in about 30 fathoms of water when under the greatest pressure of wind and tide, and the catenary curve would then be about 47° from the perpendicular; the extreme pressure to which the chain would be subjected afloat would not exceed 92 tons. The security of this sea light-tower would depend upon its moorings, which, for greater certainty of holding, should probably be Mitchell's screw moorings, within certain limits of depth, and if the chain weighing 46 tons was not considered sufficiently strong, any

* Paper read before the Institution of Civil Engineers, Nov. 13, 1855.

additional strength might be added, and would only have the effect of immersing the floating base a few inches more. In the event of any unforeseen occurrence causing the sea light-tower to break adrift, it could immediately, and with certainty, be brought up by a spare chain and anchor.



MITCHELL'S SCREW MOORING.

The extreme pressure of the wind upon this structure would not exceed 34 tons, and that would only cause the tower to incline about 1° 28′ from the perpendicular. The pressure caused by the speed of the tide at 4 miles an hour could be taken at 30 tons upon the immersed portion.

Some interesting observations made by Mr. Douglass, in 1853, at the request of the Author, on the number, height, and speed of waves, at the lighthouse in course of construction at Bishop Rock, the most westerly of the Scilly group, tended to confirm the opinion, that little or no inconvenience would result from the action of the waves, even in that exposed locality. The statement showed, generally, that waves which, when measured from the hollow to the unbroken crest, had a height of

8 feet,	were in number 35	in one mile, and	8 per minute.
15 feet,	do. 5 & 6	do.	5 per minute.
20 feet,	do. 3	do.	4 per minute.

The new form of sea light-tower was proposed to mark the sites of shoals, or rocks, or islands, which were difficult of access, lighthouses for this purpose being generally required as warning, rather than as guiding lights; it usually was of little importance whether the light was exactly upon the point of rock from which it was intended to warn a vessel, or whether it was a short distance from it, so that the existence of the danger was made manifest.

It was submitted that this form of construction might be advantageously employed for "guiding," or "fair-way" lights. The problem of exhibiting lights of any considerable altitude in very deep water had not hitherto been solved, and, consequently, the majority of the lights now in existence were not those leading into a right channel, but those which warned from a wrong one; and so long as that plan was followed, the system of lighting would be one-sided and defective. Practical men, however, now appeared to think that the old system should not be continued, and as the sea light-tower was capable of being moored in any depth of water, however great, it might be placed midway in any channels, as an invitation to the right course, and thus insure to all vessels a safer and a speedier navigation.

The lighthouse on the Skerryvore Rock occupied seven years in building, and cost upwards of £90,000; whereas, by means of the sea light-tower, the same object might be accomplished in one year, at a cost of £30,000. The site of the Bell Rock could be equally efficiently marked at a cost of about £20,000 instead of £60,000; and that of the Eddystone at about £15,000, instead of £40,000; and the new form of light-towers would possess the advantage of being accessible in all weathers.

The observations were limited to sea-marks, but if the principle of construction proved to be correct, it would evidently be applicable to floating-forts, and to almost every other description of stationary floating body, several designs for which were exhibited.

ON THE COMMERCIAL ECONOMY OF WORKING STEAM EXPANSIVELY IN MARINE ENGINES, WITH DESCRIPTION OF A NEW DOUBLE EXPANSIVE MARINE ENGINE.

By Mr. EDWARD E. ALLEN, of London.

(Continued from page 265.)

The importance of the gain in cargo-space may be thus estimated, taking the Australian vessels as an instance:—

	£	s.	d.
Supposed capital of Company	£100	0	0
Working expenses supposed at 65 per cent., with the coals 25 per cent	65	0	0
To pay 5 per cent. the receipts must be	70	0	0
With engines increased to 3 times size—			
The capital increased to	£130	0	0
Working expenses reduced by saving of 43 per cent. off coals at 25 per cent	54	5	0
To pay 5 per cent. the receipts need only be (£54 5 0 × £6 10 0)	60	15	0

But the receipts on former supposition are £70, showing an addition of 7 per cent. on the increased capital, or 9¼ per cent. on the original supposed capital.

To this add from 7½ to 15, say 10 per cent. on receipts, extra cargo-space, equal to £7.

	£	s.	d.
This gives, total receipts	£77	0	0
Working expenses	54	5	0
Balance for dividend	£22	15	0

This on £130 equals 17½ per cent.

It can be shown also that, with *improved machinery*, comparatively no extra capital would be needed, and that no additional space would be required in engine-room; so that a *saving of* 43 *per cent.* in coal would give 10¾ per cent. on capital in the case of Australian vessels, and add besides from 13½ per cent. to 27 per cent., say 18 per cent. to the cargo-space, and consequently to the receipts.

	£	s.	d.
Thus, capital	£100	0	0
Working expenses reduced to	54	5	0
Receipts as before, £70, to which add 18 per cent. = £12 10 0 for extra cargo-space, making total receipts	82	12	0
Leaving for dividend	£28	7	0

In the foregoing paper, the object of the author has been merely to collect a few particulars of the different classes of vessels, and to give a rough approximation to the effects which would be produced by a certain saving in fuel, even did no alternative exist but that of increasing the size and weight of the engines.

There does not appear to be much doubt about a *saving in fuel*, even of 40 *per cent.* being made by *expansive working*, considering what is now the general average consumption.

If the present ordinary consumption be taken at 4½ lbs. of coal per indicated horse-power, a saving of 40 per cent. would reduce it to 2⅗ lbs. per horse-power; and this quantity will appear ample, when it is considered that many land-engines are working with 2¼ lbs. per indicated horse-power.

The pressure of steam assumed in the foregoing calculations of the saving of coal, where different sized engines are employed, has been only 20 lbs. above the atmosphere. A very much larger saving would, however, result, if steam of a higher pressure were used. The principle upon which the engines are supposed to be altered, is that of increasing the diameter of an ordinary cylinder, presuming the stroke to remain the same.

As the interests of marine engineers and steam-ship builders must, in the long-run, be identical with those of the merchants or companies employing them, it is clearly of the utmost importance to endeavour by every means to economise fuel. Little, however, can be hoped for, so long as the merchant determinately refuses to pay for that economy in some shape or other. It is not to be expected that engineers will supply larger engines than custom necessitates, and for which they obtain no additional payment; nor will they exercise their talents to economise in that direction which appears least appreciated.

Considerable competition has for a long time existed amongst engineers for the purpose of reducing the space occupied by engines; but this has been done without reference to the question of economy in total space of machinery and coal, or without reference to economy in consumption of fuel.

This competition has been, nevertheless, productive of much good, as reduction in weight and space occupied by engines is of the utmost importance, other things remaining the same.

It is believed, however, that when the subject is better understood by merchants than it appears to be at the present time, they will no longer refuse to purchase the economy when offered to them.

Were the Government now to throw open a contract where *economy in fuel* was the object sought, in the same manner as they did some years ago, when *economy in space and weight* were the objects, we might look for the same or greater benefits than then resulted from so advisable a plan.

The author has now to show in what manner he believes nearly all the advantages enumerated in the foregoing tables can be obtained, by a peculiarly constructed engine of his invention, adapted for the *expansive use of steam*, without those disadvantages which have doubtless prevented the more general adoption of the principle of expansion in marine engines, viz., the increased size, weight, and cost of the engines.

The degree of expansion to which it is necessary to work in order to obtain great economy, would seem to require an arrangement of engine different from the ordinary one; inasmuch as the great variation of pressure from the beginning to the end of the stroke would cause considerable irregularity in the working of an engine where no fly-wheel can be employed. Added to this objection, there is also another of equal importance—the necessity of making all parts of the engine (where a single cylinder of large capacity is used for expansive working) strong enough to resist the greatest strain to which they are subject, namely, that at the commencement of the stroke; the weight and cost of engine rising also in a corresponding degree with its strength. In order, therefore, to overcome these objections, and adapt it for marine purposes, it seems necessary that an engine should be arranged on the following principles :—

1st. That the steam on its first entrance should act upon a comparatively small area.

2nd. That it should finally expand to a considerable extent, the limit being determined by the friction of the machinery and the pressure of uncondensed vapour in the condenser.

3rd. That the variation in total pressure from the beginning to the end of the stroke should be as small as possible for any given expansion.

4th. That the work done by the in and out strokes (*i.e.*, of a horizontal screw engine) should be equal, or as nearly so as possible.

5th. That the horizontal or floor space occupied should be as small as possible—the height not being of great importance if within, say, 6 or 8 feet.

6th. That the strain upon all parts of the engine should be as nearly uniform as possible, and not concentrated at any portion of the stroke.

7th. That the steam from its entrance to its exit should work against a vacuum, if possible.

The arrangements shown in Plate 56 meet to a considerable extent the above conditions. They are all upon the *double* expansive principle, and therefore may be said to work with both high and low pressure steam.

Figs. 1 and 2, Plate 56, show an arrangement in which the high-pressure steam enters in the upper part of the cylinder, and presses upon the *annular* space A A round the trunk—this being comparatively a small surface; it is cut off at $\frac{1}{4}$ or $\frac{1}{2}$ of the stroke, according to circumstances, and then is passed to the lower end, B, of the cylinder, in which it is expanded to the extent required—this being in the ratio of the annular space to the whole area of cylinder. During the time the high-pressure steam is acting on the annular space A A, the lower part, B, of the same cylinder is open to the condenser C; and while the steam is expanding in the lower part of the cylinder, on an area equal to that of the trunk D, a vacuum is maintained in the bottom of the *opposite* cylinder F, and so admits of the greatest degree of expansion. The trunks D, E of the two opposite cylinders being firmly connected together by the rods H, H, causes the pistons of both cylinders to move simultaneously, and the gross power exerted in each direction is made up of the pressure of the high-pressure steam in one cylinder, and the expanding steam in the other or opposite cylinder. The trunks are for the purpose of shortening up the engines as much as possible.

The main features in this arrangement are, first, that the atmospheric pressure on the outer end of the trunk is counterbalanced, which if not done would prevent the steam being worked so expansively, as the pressure of the atmosphere on the trunk would be added to the pressure of the high-pressure steam which is not required, and would have to be balanced by the expanding steam, which (in order to maintain an effective moving power) could not then be expanded to the same extent; and secondly, that the high-pressure steam acts only upon a comparatively small area.

Fig. 3, Plate 56, shows an arrangement by which an objection to a large trunk could be overcome. This plan is much the same as Sims' arrangement, only having a trunk, D, attached to the pistons for economising space, a vacuum is here maintained *constantly* in the space G G between the two pistons; the high-pressure steam acting on the bottom of the small piston at A, and afterwards expanding in the annular space B B. The trunks D, E, being small in this case, the same necessity would not exist for combining opposite trunks together; though, in the event of the power being large and four cylinders employed, an evident advantage would follow.

Fig. 4, Plate 56, shows an arrangement by which an engine on the above plan could be made double-acting — that is, having high-pressure steam admitted on *both* sides of the small piston at A and E E alternately, and using *both* sides of the large piston B B and G G alternately for expansion. This is done in the way shown—the cylinders being distinct, and the trunk D being encased, as it were, by a tube through the large cylinder—thus avoiding any internal stuffing-box. In this arrangement the large piston is an *annular* one, and the junction between the two pistons is made *externally* by two or more piston-rods, F F, being attached to the large piston and to the trunk.

There are several other forms in which the same principles may be carried out.

In Fig. 1, where only two cylinders are required, the atmospheric pressure on the trunk may be counterbalanced by an opposite *piston* or *trunk* working in a fixed cylinder or condenser, having a vacuum maintained in it.

The modifications would all depend upon the particular objects sought, and the conditions to be fulfilled in each case.

The CHAIRMAN observed, that the subject of the further development of the expansive principle in the different forms of steam-engines had become one of great practical importance, and had been at present only very partially carried out. They were most probably only on the threshold of extensive improvements in the steam-engine, and particularly in the application of the expansive principle, combined with higher pressures than had been hitherto generally used. The degree of expansion of the steam was seldom carried at present beyond about three times; but he thought it might be carried up before long to ten times, or even higher, the important economy of which had been so ably shown in the paper read by Mr. Allen. To carry this out thoroughly, so as to obtain the full commercial benefit of the economy that was practicable, a considerably higher pressure of steam in the boilers would be requisite than was at present generally made use of. The pressure in the marine and land-condensing engines had been already increased very generally from the old limit of 6 or 7 lbs. above the atmosphere, to about 20 lbs. per square inch, and in the Cornish engines to 40 or 45 lbs.; but it did not appear impossible that this might be ultimately increased even to 100 or 120 lbs., as was constantly used in locomotive engines.

Mr. ALLEN said, that in the calculations in his paper, he had assumed an increase of pressure over the present general practice; but, to be within safe limits in reference to the present construction of marine boilers, he had not taken a higher pressure than 20 lbs. as the basis of his calculations. A considerably higher proportion of economy would, however, be obtained, if higher pressures were made practicable by employing boilers constructed on different principles from those ordinarily used for condensing engines.

Mr. WILLS remarked, that there appeared to him an omission in one part of the argument as stated in the paper, in not calculating a provision for paying back the excess of capital required for furnishing the larger sized engines proposed to be introduced, to allow of the expansion being carried out to the additional extent proposed. The interest for this extra capital had been included in the calculation; but he thought, in order to make a complete commercial comparison, an additional annual amount should be set apart for paying off the extra capital itself within the period of the lifetime of the engines, as their durability could not be considered as increased by their being enlarged. He thought this consideration might partly account for the want of attention on the part of steam-boat companies to the application of the principle of expansion.

Mr. ALLEN said, that item had not been taken into account in the calculation; but, on the other hand, the advantage had not been taken credit for that could be obtained by the reduction practicable in the boilers from the large saving in steam, leading to a saving in first cost, and cost of repairs, as well as increase in cargo-space. These advantages, he thought, would considerably outweigh the other question of original cost of engines; and in reference to their durability, he believed it was generally experienced that large engines were better to keep up than small ones, and a lower per-centage on the capital was required for the purpose.

The CHAIRMAN inquired whether any engines had been tried on the new plans that had been described in the paper?

Mr. ALLEN replied, that none of them had been constructed at present, as he had only recently brought out the plans.

The CHAIRMAN observed, that for employing a much higher pressure of steam, a considerable alteration in the present boilers would probably be required, in order to obtain the requisite strength, particularly in the marine boilers, in which there was at present so large an extent of flat surface. An extensive series of experiments was now making, he understood, by the Admiralty, on working steam-vessels with increased pressures, which would probably afford important results.

Mr. ALLEN said, that the present limit of pressure was probably about 30 lbs. in steamers, on account of the practical difficulties that were experienced in the construction of boilers of sufficient capacity for very large engines, and with the compactness requisite for the situation of marine boilers, and at the same time suitable for very high pressures; the principle of boiler adopted in locomotive engines, the only one in extensive practical use for such pressures, being unsuitable in the other respects.

Mr. JACKSON thought the extension of the expansive principle in steam-vessels would be an important advantage, as marine engines were undoubtedly much behind others in that respect. It would probably be carried out more extensively by private companies, as they were generally less limited in the pressure of the steam than in the Government vessels; and it would be particularly applicable to them, as their commercial success was dependent on their cargo-space, so large a proportion of which was at present lost by the room occupied by the coals requisite with the present imperfect construction of engines.

Mr. MILLER inquired whether there was any law preventing high-pressure steam being used, or limiting the pressure in steam-vessels?

The CHAIRMAN said, there was no legal restriction in this country; it was only on the Continent, he believed, that a limit was fixed for the pressure allowed in working boilers. In the Government steamers, the boiler-pressure was limited for a long time to 10 lbs.; but a great advance had now been made, and in the new gun-boats high-pressure non-condensing engines had been introduced working at 60 lbs. per inch, which would probably be followed up by very important alterations and improvements in marine engines.

Mr. ALLEN observed, that in the expenses of working steam-vessels, the cost of coal bore such a large proportion to the other expenses, forming the largest item of the whole, that the question of economy mainly rested on diminution in the consumption of fuel; and they could afford a considerable loss in the weight and cost of the engines, in consequence of the greater ratio of gain in the cargo-space from the reduction in the quantity of coal required, and the saving in cost of coal. The question of relative increase in cargo-space was one of great commercial importance, as the loss at present from the large space in the vessel required for coals was very serious: a saving in capital, at the expense of cargo-space, would be a loss on the whole; whilst even at an original sacrifice of capital, from the greater proportionate increase of cargo-space, a larger ratio would be gained of returns for profits. In the tables given in the paper, the calculations had been made at the moderate pressure of 20 lbs. per inch, with cylinders enlarged three times in size, and cutting off the steam at one-seventh of the stroke; with a higher pressure of steam, the expansion could be carried to a greater extent, and still further economy obtained.

The CHAIRMAN observed, that the subject was one of great practical importance, and the valuable and extensive calculations in Mr. Allen's paper threw great light on the commercial advantages and practicability of extending the application of the expansion principle. He suggested that the discussion be renewed at the next meeting, and hoped that Mr. Allen would be able to bring forward, on that occasion, further extended calculations, carrying out the same investigation with higher pressures of steam, from 20 lbs. up to, perhaps, 100 lbs. per inch. He proposed a vote of thanks to Mr. Allen for his paper, which was passed, and the discussion was adjourned.

The meeting then terminated.

MARINE PROPULSION: OR, THE INFLUENCE OF "FORM" IN PROPELLING BLADES.*

By THOMAS EWBANK, Washington, D.C.

A CONVICTION that the principles of propelling, partially unfolded in the experiments first reported in the Journal,† and embodied in the Patent Office Report of 1849, must eventually be recognised, induces me to offer the following remarks on the subject:—

An increase of speed in ocean-steamers is of acknowledged importance to the commercial and social interests of the world. Is it attainable? Yes; for no truth is more certain, though it may not be perceived, or but dimly perceived, that every acquisition in the arts is a step in the order of progression that serves, or ought to serve, as a fresh starting-point to enable us to keep rising in mechanical knowledge, and in its applications. How, then, is it to be achieved? Not by blind experiments, which have been tried long enough. In common with the lower tribes, we can meet exigencies in the arts with instinctive devices, and continue to meet others by the suggestions of experience; but there is a limit to empiricism, and then, in order to advance, an appeal to principles becomes necessary, because new bases of operation are wanted,

---

* From the "Journal of the Franklin Institute."

† See vol. xvii., p. 42.

which are not obvious to sense, and which nothing but an investigation of principles can disclose. To some extent this is, I think, applicable to steamers. There is an element in the propulsion of vessels that has hitherto been overlooked, and upon it, I believe, the next step in advance must be based.

I wish to urge the value of *form* in propelling blades, for I am sure that in it is to be realised the desideratum of speed. A correct outline is everything in those instruments, because every desirable quality *flows from it*—qualities which it is impossible to realise with the old rectangular planks in common use. I question if a grosser example of neglect of form than these present can be named, or where the consequences have been so serious—examples of greater looseness about principles and greater persistence in malpractice. Among the higher or even lower classes of machinery few such deviations from rectitude can be found, and fewer still that have been so long borne with. But it has happened to them as to other characters whose proclivities to wrong-doing are innate—they have been endured till a sense of their deformities has vanished.

Though we may bungle along with misshapen blades, we cannot elude the penalties attached to them, as great waste of power, unnatural wear and tear, constant straining of the vessel, no marked increase of speed, and a premature breaking up of the whole. Of this severe punishment for neglect of form the history of steamers is replete; but, unfortunately, offenders are insensible to the offence, and to what it costs them. This is not, however, the case in all things; and hence, while steam-ships still spend much of their costly power for naught—while their wheels continue uselessly to thrash the water and heave up tons over them—while their machinery is jarred, and their massive shafting now and then wrenched apart by excessive strainings, the hulls are not kept in such violent and ceaseless paralytic tremblings as formerly. Modern vessels outstrip former ones because their outlines have been improved; and when equal efforts are made to improve those of propelling blades, steamers will begin to be what they ought to be.

Admitting that much is to be done in the construction of vessels and in motive machinery, their rate of going must continue to depend on their propelling apparatus. While it is defective, fleetness is unattainable, though all things else were perfect. The finest formed flyers move heavily with crippled wings, and we can have no swift skimmers of the seas with deformed organs of motion. Believing, as I do, that success is to be found in the true form of propelling blades, the following observations are submitted to marine engineers. Should they conclude that there is nothing in them, nor in the simple proposition itself, I would ask in what direction do *they* expect to succeed? On what other parts of a steamer do they propose to operate? On the hull, the boiler, the engine, or the wheels? On the number, width, depth, and dip of the buckets, &c.? Surely, on these points nothing decidedly new or promising can be expected, much less the development of *new elements* of propulsion; for, after all, that is what is wanted. The squeezing out, by extraordinary exertions, of a few more feet or rods to the hour will not satisfy the present age, let alone future ages. It would only show that the virtue of the present paddle is exhausted; that nothing, or next to nothing, more is to be got out of it.

But are new elements of speed to be elicited from the mere shape or outlines of the blade? Yes. But paddle-blades have long been experimented on, and the result has led to the universal preference of the original rectangular slabs, and to the recognition of the primitive wheel as "the prince of propelling devices for speed?" True, and the fact is conclusive that the existence of virtue in the *form* of the buckets is not suspected. It is not sought for, and consequently not found. Planks were the readiest forms and materials at hand in the beginning, and were with little reflection adopted, just as they have been continued. It is demonstrable that the highest attainable speed is impossible with paddle-planks—utterly impossible, and that it can only be attained in connexion with other engineering desiderata; such as the least waste of power, the least amount of material in the blades, the diffusion of the resistance over their entire surfaces, every section producing equal effects though very unequal in area, the centre of resistance not at the extremity, but in the centre of the blade, and thereby putting the least strain upon the arms or levers. When these properties, and the utmost *thinness* in blades, their smooth working, freedom from liability to sudden or increased strains, are acquired, the true form will have been obtained, and, what may appear problematical to many, they will be found to have proceeded from it, illustrating a cardinal truth in physics, that in proportion as a device approaches the truth in form, it approaches it in every other particular.

It is, however, a melancholy fact, that there is among our engineers a prevailing indifference to and unbelief in the value of form, which can only be ascribed to their not having looked into the subject. They do not perceive how two blades of equal areas, but differing in their outlines, should possess different properties; surface, not boundaries, being what they rely on.

That there is an innate relationship between cause and effect, and that the latter is modified by the instruments through which the former acts, is obvious to everybody. A blunt, that is, a badly-formed tool, consumes more power than a sharp one, and gives inferior results: so it is with everything through which force is conveyed. Mechanical science rests upon principles that determine forms and proportions. *There is of necessity a best form for everything and for every purpose.*

What, then, is the form of propelling blades which communicates properties not found in common ones? In general terms, it is that which is exemplified in nature's blades. The law that determines them makes them *long, narrow, tapered* and *pointed,* and contracts and expands these features as speed is to be diminished or increased. The form and application are antipodal to rectangular buckets, because the blade must taper as it dips: the deeper it enters the water, the narrower it must become.

The effects of this simple change of form are as surprising as they are important. The most essential attributes of a propeller are evolved.

1. *The least amount of material in the blades.* They are not made uniform in thickness, but are thinned away towards their extremities—a feature incompatible with rectangular blades.

As the reduction of thickness of natural blades outwards is a permanent feature under all circumstances, it might have been inferred from that fact that the same trait might be indispensable to success in artificial propulsion. It has not been so inferred, and we are therefore led at once to inquire why natural blades are reduced outwards, and to a mere film? Because length of stroke virtually *diminishes with thickness,* and *a waste of power keeps pace with it.* This is demonstrated in our paddle-wheels. If a pair of these were made in the form of close drums or solid cylinders, they could of course have no propelling power whatever; no more than have grindstones revolving in their troughs. Suppose half of each removed, and the usual number of arms and buckets or blades put in their places, the wheels, as they might then be called, could have only half the usual power; and if one-third, one-fifth, or any other proportion of the cylinder were left, in the same proportion would their capacity for propulsion be neutralised. It is, therefore, an inexpugnable truth, that whatever may be the number of blades in a wheel, the sum of their thickness must be deducted in every revolution from their sweep through the water, in order to determine their propelling capacity or the work they should perform. In the supposed case of half the wheels being solid, the semi-cylindrical masses were simply distorted blades.

Taking the mean thickness and number of the massive planks that constitute the blades of ocean-steamers, they lose from this cause from eight to ten feet of stroke in every turn of each wheel. Assuming two hundred and fifty thousand revolutions as the average number in a trip across the Atlantic, over five hundred miles of stroke are thus lost in each wheel; or, in other words, between twenty and thirty thousand pounds of timber are whirled that distance through air and water, and to no purpose but consuming power and wearing out the motive machinery. We may commit all manner of delinquencies in construction, but we cannot harmonise a philosophical truth with an opposite error. *Thinness* of blades, and the *least material* in them, and the consequent least expenditure of power, depend upon form. There is no separating them. Instead of being tapered away toward their extremities as in natural instruments, ordinary blades are made as blunt there as anywhere else. They are, in fact, often made thicker by bolting on additional slats; and they require this, since the resistance is accumulated there.

2. In the *reduction of the number of blades.* The adoption of tapered ones would enable us to throw overboard two-thirds or three-fourths of the number now used, with the same proportion of shafting, as not simply useless, but positively injurious. This cannot be done with the present blades, on account of the jarring caused by their violently slapping the water as they come down upon it. When few blades are used, the effects of this are seriously destructive; and hence to reduce the concussion the number is increased, on the principle of dividing a few large blows into many little ones. Some boats have had seventy-two blades on each wheel; many have now thirty-six. Thus, one error called in another; for it was not perceived that as their number was multiplied, their efficacy was diminished.

A correct form would have removed the evil at once, and the cause of it. Instead of a propelling surface, extending from twelve to fifteen feet from a vessel's side, being brought in sudden conflict with a wave, a mere point of the blade would have been presented to it. Instead of attempting to arrest the swell, and be shaken or carried away by it, it would go softly and silently into and through it.

3. In *removing the centre of pressure* from near the extremity *to the centre of the blade,* and in an *equable distribution of pressure over its face.* It is the characteristic of a good and durable instrument, that its material is so distributed that every part contributes its due proportion of influence towards the intended result, *and no more.* No other criterion than this is required to determine degrees of worth or worthlessness. How is it with rectangular blades? Why, in truth, it must be admitted that in this respect they are defective, and to a degree which, I suspect, can hardly be paralleled in modern mechanism. Their lower parts, sweeping through greater spaces in the same time than those above them, do most

of the work, nearly all of it, and thus destroy the equilibrium of pressure on the face of a blade, which, *above all things* else, should be secured, and introduce an element of destruction that reaches from them to everything connected with them. One-third of a steamer's blades have been removed from their upper parts without diminishing in the least her speed; a result that might safely be predicted of some boats now running.

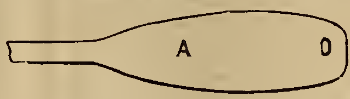
An equable distribution or equilibrium of pressure on a surface whose several sections are immersed at unequal depths, and moved with unequal velocities, might seem impossible on a first thought; but a second one would suggest that there must be, *per se*, some provision of the kind for this class of movements, as there are for others, and that, too, by varying the outlines of the surface without enlarging it—a principle equivalent to that exemplified in the lever by simply moving the fulcrum, and, in fluids, to that by which a pint of water may be made to balance a gallon or a thousand gallons; THE principle, in fact, which raises or lowers the centre of pressure on a blade, not by adding anything to it, but by merely widening or narrowing it—*which modifies velocity by surface, and surface by velocity*, so that every portion meets only its proper amount of resistance, and all portions harmonise in bringing out one result.

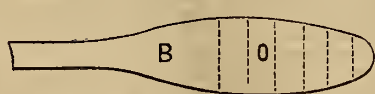
4. Another beautiful result is, that though the blades may taper to a point, a section near that point does just as much work as an equal section through the widest part; extended sweep compensating for diminished surface.

Such are some of the results of form in propelling blades, and they are what are now wanted to enable us to begin a new career in ocean-steamers.

Variously-shaped blades have been tried on the stern-submerged propeller, but for them no definite form has been developed. Most of them are as wide of the truth as the planks of side-wheels. The resistance is accumulated at their extremities; the largest extent of surface is there, and consequently the greatest strain upon the levers or arms and shafts. The true form, whether worked at the side or stern of a vessel, is only to be determined by the properties named, and, as already remarked, they are applicable to every propeller. The law makes no discrimination in favour of one application over another.

The blades of *oars* partake of the same defect as those of steamers' wheels, though in a less degree, because of their being applied in the direction of their length, instead of being attached across the ends of their levers. Uniform in width, the parts farthest from the centre of motion move with greater velocity than the rest, and hence it is the end of an oar that does most of the work; portions in the rear move slower than it—they are *behind* it in their action, and cannot therefore sympathise or coalesce with it. In some oars the ends of the blades are wider than the other parts, when the defect is still greater.





To enable an oar-blade to return an equivalent for the power transmitted, it should diminish in width from near the middle of its length, and in such a ratio that every part may perform an equal proportion of work, and in *unison* with every other part. In the common blade, A, the centre of resistance from the water is near O; but let *the same amount of surface* be formed like B, and the centre of resistance would be at the same distance from the centre of motion, while the end of the blade would be thrown further out, and greater effects obtained by the same power. Every section, from the middle of the blade to the pointed extremity, would then be equally effective, though so unequal in area, because its surface, multiplied by its velocity, would give the same resultant as every other section. In such a blade no part could embarrass the perfect action of any other part. All would be in accord.

The object of the foregoing remarks is to awaken attention to a problem in practical science, than which there are few of greater and none of more immediate value.

It is greatly to be desired that the Government would institute, through a commission, a series of experiments to determine the true forms and proportions of propelling blades. The report would be of permanent and world-wide interest.

REVIEWS AND NOTICES OF BOOKS.

Sheridan Muspratt's Applied Chemistry.

(Continued from page 237.)

UNDER the head "Cements" we notice a remarkable statement. Treating of the uses of silicic acid, the author observes—"It is met with in two states—in rocks and minerals—namely, the crystalline and the amorphous. Rock crystal, quartz, the *diamond*, and many other bodies contain it in the first condition, while opal, flints, and similar compounds contain the amorphous variety." The diamond we have always concluded to be a crystalline variety of pure carbon, which, when burnt, is resolved entirely into carbonic acid.

The manufacture of cheese occupies an extensive article, the mechanical operations being described with as much care as the chemical. This procedure, which we have already noticed under other heads, is a departure from the professed object of the work. Dissertations on the most approved forms of churns and cheese-presses might be very suitable in a general dictionary of manufactures.

The adulterations of cheese are few and simple: mashed potatoes—a fraud more upon the pocket than the health of the consumer—are abundantly added. Their detection is easy: boil in water, and add a little tincture of iodine to the cold decoction, when a blue tinge will betray the presence of starch in any of its forms.

Lead and mercury have also been found in highly-coloured cheese. This is a fraud, however, perfectly unintentional on the part of the farmer, who, in purchasing annatta—a colouring matter in itself perfectly harmless—frequently obtains a mixture of red lead, cinnabar, &c. It is to be regretted that the public does not prefer cheese of the natural colour, which would remove the possibility of such dangerous admixtures. To judge of articles of food by their colour is altogether one of the most absurd notions ever entertained by mankind. It is this folly which has introduced copper into our pickles and jams, catechu, French chalk, and Prussian blue into our tea, logwood into our wine, and chrome yellow into our confectionery.

The dangerous substances sometimes produced during the decomposition of cheese are slightly mentioned. Prussic acid has not, as was once supposed, been detected in unsound cheese; but Taylor has found sesqui carbonate of ammonia and an acrid oil. On the Continent, however, cases of fatal disease from the use of unsound cheese are not unfrequent. The exact character of the poison is far from being determined. Many eminent chemists maintain that cheese in this state contains a peculiar ferment which propagates decomposition through the body, just as is the case when the venom of serpents is introduced into the blood. To this it is replied, that all such ferments, even animal matter in an advanced stage of decomposition, are destroyed by the juices of the stomach, and only prove fatal when introduced directly into the blood.

The ingredients of cheese are caseine, fats, salts, and water. The former of these ingredients ranges from 45 to 25 per cent., and is of high nutritive value. It appears to be derived without any remarkable metamorphosis from certain nitrogenous substances—according to Mulder, *proteine* compounds—contained in the vegetables upon which the cow is fed. In a state of purity it is obtained by adding a trace of acetic acid to skimmed, straining, washing, and pressing the curd, and repeatedly extracting the mass with alcohol and ether till all fatty matter is removed. It is remarkable that in course of time the caseine in cheese returns to a soluble condition, as it originally existed in the milk, and may be again coagulated by acids.

Few persons are aware that cheese may be prepared from vegetable substances, such especially as contain caseine. The Chinese have in this manner manufactured cheese from peas and beans from time immemorial.

The flavour and odour of old cheese is derived not from caseine, but from the fatty matter (butter) present, which in course of time is decomposed into the butyric, valerianic, caproic, caprylic, and capric acids.

The quality of cheese is influenced not merely by the method of its preparation, in which there is still much room for improvement, but also by the soil upon which the animals are fed.

A Treatise on the Principles and Practice of Levellers, &c. By F. W. Simms, F.G.S., M. Ins. C. E., &c. 4th Edition. London: John Weale, High Holborn. 1856.

THE occasion of the issue of a fourth edition of Mr. Simms' work appears to be that the previous editions are out of print.

The *popularity* of an author has been said to be surely indicated by the extent to which his work appears upon the second-hand book-stalls of the metropolis; but it does not follow that popularity, in this sense, and the esteem in which an author's works are held, imply one and the same thing: inasmuch as the more recent of the previous editions of this work are not commonly to be found in such places.

Mr. Weale has availed himself of the present occasion to correct some of the errors which were discovered to exist in the previous editions; and has added to the work of Mr. Simms some excellent practical examples of setting out railway curves, by Mr. Henry Law; and also a valuable treatise by Mr. John C. Trantwine, a civil engineer, extensively employed by the United States' Government.

The mode in which Mr. Trantwine has handled his branch of the subject, viz., "The Field Practice of Laying Out Circular Curves for Railroads," demands the highest commendation; he has used the most intelligible language for conveying clearly the information he professes to impart, and, in illustrating the various subjects under the heads of twenty-two articles, has so practically exhibited the best examples, and, where practicable, has given more than one rule by which a result may be obtained. Some of the rules are peculiarly his own, and, we think, they possess simplicity in an eminent degree, and sufficient correctness for all practical purposes.

The Table of Natural Sines and Tangents to single minutes is admirably worked out, and in a sufficiently portable form for field use. In his preface, speaking of the tables, he says:—

"One object in preparing it, was to furnish the profession with a table that should be not only portable, but *absolutely reliable.*

"Those whose occupations compel them to resort to the tables in common use, must have frequently experienced the embarrassment which attends the inaccuracies to which they are all subject. So long as a table is known to contain a single error, the position of which is not ascertained, its employment is attended with doubt in every instance in which we are obliged to refer to it."

And he adds the following corrections of Hutton's Tables:—

"As Hutton's Tables of Natural Sines and Tangents are those most in use among the profession, it will be desirable to those who possess them, to be able to correct the following errors, which I detected in comparing them:—

In Hutton's Tables, fifth edition, 1811.
Sine of 6° 8′, for ·1063425, read ·1068425.
Page 328, at top, for 25 deg., read 40 deg.
Tangent of 44° 60′, for ·1000000, read 1·000000.
Tangent of 41° 60′, for ·8994040, read ·9004040."

Also:

"*In Dr. Gregory's corrected edition (the 8th) of Hutton's Tables,* 1838:—
Sine of 49° 14′, for ·7576751, read ·7573751.

In Hasslar's Tables, 1830:—
Sine of 78° 24′, read ·9795752.
Sine of 20° 60′, „ ·3583679.
Sine of 66° 19′, „ ·9157795.
Sine of 56° 39′, „ ·8353279.
Sine of 55° 20′, „ ·8224751.
Sine of 53° 4′, „ ·7993352.
Sine of 48° 12′, „ ·7454760.
Sine of 45° 3′, „ ·7077236.

"The discrepancies of 1 in the 7th decimal are not considered as errors, as they are occasioned by a neglect of the value of the 8th decimal. For calculating curves it is not necessary to use more than 4 decimals."

In the preface to his treatise, and somewhat apologetically for the avoidance of scientific mysticism, or less intelligible modes of expression, Mr. Trantwine informs us that his work "has been prepared almost entirely with reference to the wants of young men who desire to qualify themselves for service in an engineer's corps, and on that account the plainest language has been used to render the subject intelligible, dispensing with mathematical brevity"

Now, we feel bound to add, that, although prepared for the engineering student, its value is equally great as an aid to the practical surveyor, who will find much valuable information therein.

How to Lower Ship's Boats, &c. By C. Clifford. (2nd Edition.)—Simpkin and Marshall. London, 1855.

We recommend all interested in the subject of lowering ship's boats safely in the moment of danger (and who is not) to peruse this pamphlet carefully. Mr. Clifford deserves great credit for the manner in which he has brought the subject before the public, and pertinaciously continues to direct the attention of shipowners and ship-masters to his plans, and we wish him success in his meritorious and life-preserving aim.

Mr. Clifford evidently understands the value of "Paddy's *purchase*," viz.: "Spun yarn round a nail," although he has reversed it in practice, and he avails himself practically of the experience gained in school-going days, when he no doubt excelled in spinning his humming-top—for he appears to have brought such matters to his aid in working out his plans for lowering ship's boats safely, and reducing and regulating strain in lowering heavy bodies.

Plates of the Sardinian Steam-ships "The Vittorio Emanuelle" and the "Conte di Cavour." Wm. Foster, 114, Fenchurch-street.

We have inspected some very beautiful coloured prints of these steam-ships, which have just been published by Mr. Foster, and executed in first-rate style by Mr. T. G. Dutton. Nothing could be more opportune, if only on account of our notice in the last month's Number of The Artizan describing the engines and machinery of the *Victoria,* as also of these vessels, which were built by Messrs. Rennie and Sons.

LIST OF NEW BOOKS, OR NEW EDITIONS OF BOOKS.

ASHLEY (J. M.)—The Relations of Science. By John M. Ashley. 12mo (Cambridge), pp. 292, cloth, 6s. (Bell.)

CAMERON (A. M.)—Wages Calculator: being Tables for Calculating Workmen's Wages, from 2s. to £2 2s. per Week, at Ten Working Hours each Day, for any Number of Hours, from One Hour to 250, embracing Twenty-five Working Days. By Alexander M. Cameron. 12mo (Edinburgh), pp. 148, cloth, 2s. 6d. (Groombridge.)

COURTENAY (E. S. C.)—Dictionary of Abbreviations, Literary, Scientific, Commercial, Ecclesiastical, Military, Naval, Legal, and Medical. By Edward S. C. Courtenay. 18mo, pp. 54, sewed, 6d. (Groombridge.)

GROOM (E.)—The Art of Transparent Painting on Glass; comprising the Method of Painting, and an Account of Implements used in Magic Lanterns, &c., &c. By Edward Groom; with Illustrations by Dalziel. 12mo, pp. 56, sewed, 1s. (Winsor & N.)

HARDWICH (T. F.)—A Manual of Photographic Chemistry, including the Practice of the Collodion Process. By T. Frederick Hardwich. 2nd edition, 12mo, pp. 352, cloth, 6s. 6d. (Churchill.)

HARRIS (Sir W. S.)—Rudimentary Treatise on Galvanism and the General Principles of Animal and Voltaic Electricity; with brief notices of the purposes to which it has been applied. By Sir William Snow Harris. 12mo, pp. 216, illustrations, cloth, 1s. 6d. (Weale.)

MONTGOMERY (J.)—The Cotton-spinner's Manual: a Compendium of the Principles of Cotton-spinning. By James Montgomery. New edition, 12mo, pp. 82, cloth, 1s. (Griffin.)

PIESSE (S.)—The Art of Perfumery, and the Method of Obtaining the Odours of Plants; with Instructions for the Manufacture of Perfumes for the Handkerchief, Scented Powders, Odorous Vinegars, Dentifrices, Pomatums, Cosmètiques, Perfumed Soap, &c. By G. W. Septimus Piesse. With Appendix, &c. Crown 8vo, pp. 290, cloth, 7s. 6d. (Longman.)

RIDDLE (J.)—Treatise on Navigation and Nautical Astronomy. By John Riddle. 6th edition, 8vo, pp. 172, boards, 10s. 6d. (Baldwin.)

BARRETT (A. C.)—The Propositions in Mechanics and Hydrostatics which are required of Questionists not Candidates for Honours; with Illustrations and Examples collected from various sources. By A. C. Barrett, M.A. 2nd edition, crown 8vo (Cambridge), pp. 200, cloth, 6s. (Bell.)

*EMMONS (E.)—American Geology; containing a statement of the principles of the science, with full illustrations of the characteristic American Fossils; with an Atlas and a Geological Map of the United States. By E. Emmons. Vol. 1, 8vo (Albany), pp. 445.

* New American Book.

CORRESPONDENCE.

SLIDE VALVES.

To the Editor of The Artizan.

Sir,—I enclose you herewith sketches of an arrangement of slide-valve, which I have introduced, and found, in practice, to answer very well; and as it may prove of some interest to your readers, I shall be glad if you will give it a place in an early number of your very useful Journal.

In forwarding you the three views of so simple a matter, I have considered that they may be useful to the young engineer, and it is in this spirit, rather than with any desire to dictate to the many able and practical engineers who read your Journal, and I always remember that suggestions of this kind, though, perhaps, not of as great and general a value or importance as are most of the subjects treated by you, still they may be useful to some; and if they be not novel, or, in the opinion of some, not as practically useful as I believe them, they will, at least, serve to direct attention to the subject, and in that way do some good.

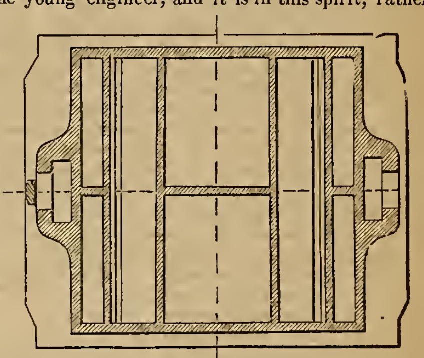


Fig. 1.

I have found great difficulties in working slide-valves, especially at high velocities, where there is a tendency to prime over from the boilers; and great damage results to the slide-face when this occurs, even when there is an escape-valve attached to the cylinder ends.

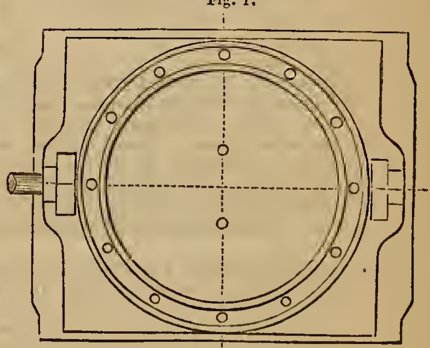


Fig. 2.

Fig. 1 is a plan of the face of the slide-valve; Fig. 2 is a plan of the top, showing the packing-ring; and Fig. 3 is a vertical section, taken through the ports, slide-valve, packing-ring, &c.

I have not thought it necessary to put letters of reference on the diagrams, as the arrangement is so simple, and will be readily understood both by your readers and yourself.

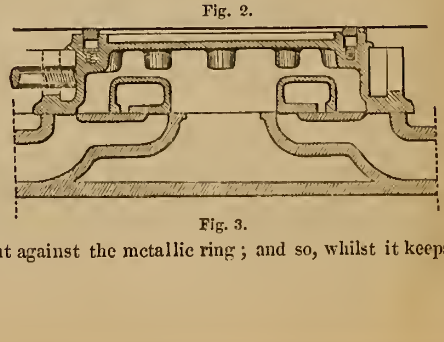


Fig. 3.

On reference to Fig. 3 you will perceive I apply a number of spiral springs, which act against a wrought-iron ring, and press the hemp-gasket tight against the metallic ring; and so, whilst it keeps the packing at a workable pressure against the valve-jacket cover, it allows of any sudden or violent action from the priming or presence of condensed water in the cylinder without the usual amount of injury to the valve-face.

It may be objected that these spiral springs are too short to act beneficially, but I have not found, in practice, that such is the case; and when they are buried in the cellular spaces allotted to them, the spring being made of proper substances, and well-tempered, they will last for a very long time, and unimpaired by constant work.

Rostock. T. Meriton.

THE COMMERCIAL ECONOMY OF WORKING STEAM EXPANSIVELY.

To the Editor of The Artizan.

Sir,—I have gone over, with some care and attention, the paper read before the Institution of Mechanical Engineers, by Mr. E. Allen, of London, and published in your two last numbers.

It is very much to be regretted that there is a tendency in the present day, with many of our public men, to diffuseness of language and excessive talking. This is exemplified more especially in politics and religion, verifying the saying of the ancient, "That men often darken counsel with words without knowledge." It would be well if those who seek to *lead* the public in matters scientific would eschew such practices, and use plain language that practical men can clearly understand.

It may be true that my dull faculties may not be able to comprehend the force of Mr. Allen's reasoning, or clearly to understand his deductions. Having, however, a deep interest in such matters, I will take the liberty, with your permission, of stating the *case* raised by Mr. Allen in my own way, when he will be able to correct me if I am wrong.

Being an engineer of rather extensive practice, I can suppose a case in which I am asked to design a steam-vessel for a given trade or traffic. I would then have to settle the tonnage, length, breadth, and other dimensions, consequent on whether the ship is to carry cargo, passengers, or for purposes of war. Having fixed these preliminaries, it now has to be considered what is the speed required, the distance to be travelled, and the *power* necessary for such a ship. Having now fixed the H.P. for such a ship, I also find that in going to market for a pair of engines, whether that may be in London, Liverpool, or Glasgow, that the dimensions of both engines and boilers are nearly the same with all our best makers. If I order a pair of 400 H.P. screw-engines, the following will be about the dimensions of the boilers :—

Fire grate surface, per H.P..... 63 sq. ft. Total.... 252 sq. ft.
Heating surfaces.............. 15 sq. ft. Do. .....6,304 sq. ft.

The size of the cylinders for such engines would range from 60 to 64 in. diameter; the speed of piston would be from 350 to 390 ft. per minute; and I know that with the above dimensions either of our best makers would guarantee an indicated H.P. of $3\frac{1}{2}$ times the nominal, or, in round numbers, nearly 1,400 H.P., and thus the consumption of fuel would not be more than say 4 lbs. per indicated H.P. per hour, or about 66 tons of coals per day of twenty-four hours at full speed.

In the supposed engines the steam would be carried down, say five-eighths of the cylinder: does Mr. Allen suggest that the same boilers should be retained with all the other parts of the machinery, the *cylinders* only being enlarged to say 70 in., and the slide to cut off at a quarter of the stroke, the same pressure being maintained in the boilers? If Mr. Allen will answer this clearly, then practical men will know what are his peculiar views, and they will be able to judge by their own experience whether there is any confidence to be placed in such elaborated tabulated statements.

I am one of those who dread tabulated matter, when collated, shuffled, and shaken about like a pack of cards. A good engineer would, in constructing, take the *best* examples which have come within his experience; he would not take good, bad, and indifferent for a *mean*, as it appears to me has been done by Mr. Allen.

I happen to know something of some of the vessels mentioned in the Tables; and I also know that such vessels were not good specimens of their kind.

Take the *Termagant*,—her original engines were four cylinders, and geared, weighing upwards of 400 tons, and 620 nominal H.P., the speed of ship being about 9 knots per hour. After many and repeated trials she was found to be utterly inefficient as a frigate, and the authorities ordered her engines to be divided,—to work direct on the screw-shaft, the boiler-spaces to be reduced nearly one-half, and the total weight to be about two-thirds of the original; and with all these alterations the speed was maintained at 9 knots. She is now one of the best frigates of her class in the Royal Navy. Knowing, then, that the *Termagant* was *over-crowded*, and *over-weighed*, I cannot accept a theory founded on such data.

Take another ship mentioned in these Tables—namely, the *Simoom*. We have heard that she is one of the finest iron troop-ships in the Navy, but that she was originally *under-powered*, and her machinery was constantly breaking down.

In passing through Portsmouth Dockyard a few weeks ago, I saw, with no little interest, that the two cylinders which had been taken out of the *Termagant* had become the foundation for a really capital-looking pair of engines, and we have seen by the papers that the *Simoom* has been tried, and that the said engines were highly creditable to the Portsmouth officers; and also that the speed of the ship had been increased from $7\frac{1}{2}$ to nearly 11 knots per hour. Here, again, is another instance which bears against receiving the deductions from such Tables.

We know what we have to pay in the shape of fuel by the present engine, per indicated H.P.: to what extent does Mr. Allen mean that he can reduce this expense, say from 4 lbs., by his increased cylinder? Let him separate all extraneous matter and stick to this simple question.

Whatever makes the marine engine lighter and more compact will be hailed as a step in the right direction: the theory in dispute is, in my opinion, a decided step backward.

Those who have well considered the *chemical* properties of *steam*, will see how easily power can be got *economically* in the *boiler*, and the engines simplified so much, as to dispense with the condensers altogether.

The return of the high-pressure ships and gun-boats from the Baltic will be looked forward to with great interest, as working out a most valuable problem in marine engineering. I am, Sir, your obedient Servant, Factus.

ON CAISSONS.

To the Editor of The Artizan.

Sir,—Mr. Mitchell's employment of brickwork as ballast for caissons is a material improvement; for, besides saving in first cost, it must be of permanent utility by preventing the injurious accumulation of bilge-water in the caisson. So his substitution of deal planks for oak is productive of economy; and an advantage of straight-sided caissons, not mentioned, is that they afford a greater length of dock for the reception of ships. One error may, however, be noticed in the paper in The Artizan for September—namely, that the caisson at Sheerness was the first wherein pumping was avoided; for in Sir Samuel Bentham's first caisson at Portsmouth, water as ballast was admitted by providing a water-tight deck, over which the tide was at pleasure allowed to flow or run away by means of valves, this provision for self-action having been a prominent feature of Sir Samuel's caisson.

It is much to be regretted that Mr. Mitchell's other improvements at Sheerness are so little known, consequently rarely furnish examples to private engineers.

Oct. 12th, 1855. I am, Sir, yours, &c., M. S. Bentham.

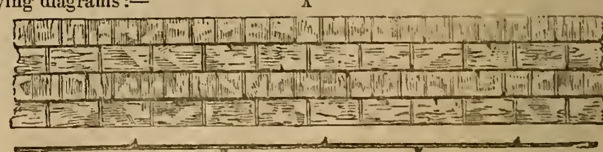
NOTES AND NOVELTIES.

Purification of Sulphuric Acid from Arsenic.—Arsenious acid, as is well known, is easily changed by the action of hydrochloric acid into the volatile chloride of arsenic. If arsenious acid be dissolved in hydrochloric acid, or if a liquid containing arsenious acid be mixed with hydrochloric acid, and then a sufficient quantity of concentrated sulphuric acid be added, chloride of arsenic, as Liebig has shown, will separate out in oily drops, and, as such, may be distilled off. Chloride of arsenic boils at 132° C., and volatilizes with hydrochloric acid vapour much under its boiling point, while concentrated sulphuric acid boils at 325° to 327° C.

I am not aware whether these facts have been made available for purifying sulphuric acid from arsenious acid, but experiments have shown that they form the basis for such a mode of purification. In fact, if sulphuric acid containing arsenic be mixed with a little hydrochloric acid and warmed, or better, if a moderate stream of hydrochloric acid gas be passed through the heated sulphuric acid, all the arsenic is rapidly removed as the volatile chloride of arsenic. I have purposely dissolved a large quantity of arsenious acid in sulphuric acid, and then treated it in this manner. The arsenic was soon so perfectly removed that trial by Marsh's apparatus gave no trace of arsenic, even after some time. After passing the hydrochloric acid through the liquid the heat may be continued for a little time, in order to drive off every trace of hydrochloric acid if necessary. I consider this process the only possible one for preparing sulphuric acid pure for chemico-legal investigations.* It is known that sulphuric acid cannot be freed from arsenious acid by rectification alone, because the boiling point of these substances are too near to each other, the sulphuric acid being, in fact, the more volatile of the two, and the precipitation of the arsenious acid by sulphuretted hydrogen takes too much time. This process offers also the advantage, that any nitrous acid which may be present is removed in the form of chloride of nitric oxides.—*A. Buchner, Ann. Ch. Pharm.* xciv, 241.

Tyerman's Patent Bond for Building Purposes.—We have recently had this improved mode of bonding brickwork together submitted to us, and we think well of it. The improvement consists in notching the hoop iron on its edges alternately, at intervals of 12 inches, as shown in the accompanying diagrams :—

A



B

A, Brickwork with the Bond built into it.
B, Plan and elevation of Bond, detached, and showing the position and form of the claws.

The pieces notched are alternately bent right and left, or up and down—forming claws or stubbs—which become embedded in the brickwork, and tie the materials thoroughly; and as it adds but a trifle to the cost of the common bind hoop to prepare them according to the patent plan, we strongly recommend it for trial.

Mortar Vessels.—Messrs. Harvey, shipbuilders, of Wivenhoe and Ipswich, are constructing four mortar vessels for the Government, which are to be ready for delivery in the spring. Two of the vessels will be built at Wivenhoe, and two at Ipswich, and will each be of 170 tons measurement.

The War Gun-Boats, &c.—If we may judge by the preparations which are announced for prosecuting the war with greater vigour next season, there is at least some hope for the future. At the present time there are, as nearly as we are able to obtain returns, about 100 gun-boats, of light draught,

* This remark does not apply to sulphuric acid prepared by distillation of metallic sulphates, which can be obtained quite free from arsenic.—Ed.

actually in course of construction, each to be fitted with a screw, and driven by a pair of engines of 30 H.P. high-pressure. These are, in addition to other description of war vessels, in course of construction in the Royal Navy yards and in the building yards of private firms throughout the country. The greatest activity prevails everywhere in connexion with the building and equipment of these vessels; and, by the spring of 1856, it is said, we shall be able to despatch to the North and East upward of 200 such vessels, of light draught, thoroughly equipped, being heavily armed, and properly manned and commanded. We hope the shipwrighting will be as energetically pressed on, as we perceive the engineering part is in advance, at least if we may judge by the numerous accumulations of engines, boilers, and screws, entirely or nearly completed, and lying in the factories and on the wharves of various engineers on the banks of the Thames. At Penn's, recently, we saw *piles* of boilers, dozens of screws, and nearly a *score* of very simple and compact high-pressure engines, completed, or all but completed, and waiting the vessels into which they are to be placed. These engines of Penn's, more particularly, struck us as strong, simple, compact, and serviceable machines for the purpose for which they are intended, and, in point of workmanship, fully maintain the high and well-established character of that firm. Whilst on this subject, we must add that when at Penn's boiler factory, we observed the very excellent manner in which the high-pressure boilers for the gun-boat engines are constructed, the absence of angle-irons, the neat and strong method in which the edges of the plates are turned up and jointed. Indeed, the unexceptionable manner in which these small boilers are produced, is well worthy of imitation by the constructors of boilers for factory engines, and we should much less frequently hear of such fearful accidents from explosions as have recently occurred. The introduction of angle-iron has cheapened boiler-making, but it has caused a very inferior class of construction to be generally introduced. The Americans generally work their boilers at much higher pressures than we do, yet explosions are much less frequent with them, and this fact is attributable to their better considering the form of the boiler and proportioning the strength of the materials used therein, and sufficiently staying them, using only the best iron, and almost totally avoiding the use of angle-iron in such works.

MORTAR RAFTS.—When at Woolwich Yard the other day, we saw, with considerable satisfaction, the progress made in completing the Model Mortar Raft, which will be fitted with a 13-in. mortar, and although we do not approve of the disposition of the materials, and the arrangements for giving that strength which is so necessary for resisting the recoil of such an engine of warfare, yet it is a decided step in the right direction, and we doubt not that the practical talent of Mr. Anderson, C.E., aiding the artillery and military engineering experience of Colonel Tulho, and his brother Directors of the Royal Arsenal Works, and others engaged in a consultative capacity, will (after the experiments, which are to take place at Shoeburyness in a few days, have demonstrated the defects of the present raft,) be fully equal to providing suitable strength and *solidity* for resisting the recoil of even larger mortars than those at present contemplated, for use on *board* these most important and much wanted additions to our Baltic Fleet.

One hundred of these craft, and the flotillas of gun-boats preparing for leaving by *next* spring, will enable us to set at naught the natural shoals and artificial obstructions in and about the mouth of the Neva, and our naval commanders will then have an opportunity of advancing upon St. Petersburgh, after giving a good account of the "Sebastopol of the North."

WORSSAM'S MOULDING MACHINE.—This machine, of which we have given a Plate and description (*vide ante*, pages 235, 255), will cut four 2-inch mouldings at one time, at rates varying, according to the stuff to be cut, from 8 to 25 feet per minute. Thus, in deal, with which the fastest feed may be used, it would cut 100 feet per minute of 2-inch mouldings. Messrs. Worssam and Co. have now by them some specimens of 2-inch mouldings cut by it, at the rate of 100 feet per minute, so clean as not to require any extra work after leaving the machine.

THERMOGENIC APPARATUS.—For some time past there has been a machine at work on the Quai Valony, at Paris, which furnishes a considerable quantity of steam without any other source than that of friction. The machine consists of a cylindrical heater 2 metres long, 50 centimetres in diameter, having throughout its whole length, placed in its centre, a conical tube. The water, which is reduced to vapour, fills the void space between the inner walls of the tube or cylinder and the outer walls of the conical tube. Into the conical tube is passed a cone of wood, covered throughout with a braid of hemp rolled upon it spirally. The wooden cone is traversed by an iron axis, and fills exactly the interior capacity of the tube, so as to rub constantly against its walls. It is put in motion by a fall of water from the Canal St. Martin, so as to make about 400 revolutions per minute. The heat produced by the friction is sufficient to convert the water contained in the cylinder into steam. A thermometer placed within the boiler indicates, at the end of a certain time, a temperature of 130° C. The boiler is strengthened in the ordinary way, and is furnished with safety-valve, stop-cocks, a float, manometer, &c. The vapour reaches a pressure of nearly two and a half atmospheres. A lubricating apparatus constantly conveys to the envelope of the wooden cone the oil required to permit of its surface moving upon that of the interior of the conical tube. This machine holds 400 litres of water. To set in action requires the power of two horses, it then produces sufficient steam to drive a one-horse engine. The inventors, MM. Beaumont and Major, hope thus to be able to utilise the force of falling water, and convert it into heat. This machine was at work at the Crystal Palace of Paris.

NOTICES TO CORRESPONDENTS.

H. HOWIE.—Yes; our Agent in New York will be able to supply them.

R——, Paris.—We are much obliged for the suggestion. As to the second question, our articles on the Paris Universal Exposition are by an eminent Engineer, who visited the Exposition, and has written the articles specially for THE ARTIZAN. They will be continued monthly, until the subject is fully and fairly laid before our readers.

GEORGE BELL.—Boiler explosions have certainly been of very frequent occurrence recently. Anything in the way of practical suggestions for the prevention of such accidents will be carefully considered, and, if approved, will be published.

NEUVILLE, Rochefort.—Your letter on the subject of the French Floating Batteries is noticed elsewhere in the present Number.

R., O. P., Q. E. D., PLYMOUTH, D. (Hull), P. WALKER, and R. GRIFFITHS, will be answered by post; as will also D. (as to Mississippi), if he will forward us his address. This month we are more pressed than ever.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 20th June, 1855

1405. W. C. Holmes, Huddersfield—Gas.
1411. G. M. de Martinoi, Valesolis, Tuscany, and J. F. O. De Lara, Spain—Material for paper.

Dated 21st July, 1855.

1650. A. Tooth, 14, Mincing-lane—Curing flesh and hides of animals in an entire state.

Dated 26th July, 1855.

1693. C. Schiele, Oldham—Motive-power.

Dated 31st July, 1855.

1737. G. J. Dalman, Alfred-villas, Kingsland—Earthenware glazes. (A communication.)

Dated 18th August, 1855.

1870. O. J. Henry, Paris—Bookbinding.

Dated 21st August, 1855.

1800. G. Lewis, Leicester—Gloves.

Dated 23rd August, 1855.

1011. W. L. Thomas, Chapel-place—Projectiles.

Dated 25th August, 1855.

1031. H. Le Franscois, Vauxhall—Cleauing stewpans, &c.

Dated 30th August, 1855.

1963. W. Gossage, Widnes—Carbonates of ammonia.

Dated 1st September, 1855.

1980. W. Smith, 10, Salisbury-street, Adelphi—Smoke-consuming furnace. (A communication.)

Dated 11th September, 1855.

2055. T. Heaton, Blackburn—Pumps.

Dated 15th September, 1855.

2081. P. F. Wohlgemuth, 57, New Bond-street—Bridges.
2083. H. Chandler, Birmingham—Roasting-jacks.
2085. D. Hill, Tipton—Material for resisting fire in furnaces, &c.
2087. G. Humilton, Great Tower-street—Weighing apparatus.
2089. L. D. B. Gordon, Abingdon-street—Electric Telegraphs. (A communication.)

Dated 17th September, 1855.

2003. U. Scott, Duke-street, Adelphi—Vehicles.
2005. E. Gibbs, Wolverhampton — Picture-frames, vases, busts, &c.
2097. N. Turner, Chorley—Gold wire and gold plate.
2099. G. Copland, Liverpool—Fluid compound for destruction of bugs, &c.
2101. J. H. Destibeaux, Paris—Waterproof fabric.
2103. C. T. and E. B. Bright, Liverpool—Electric telegraphs.

Dated 18th September, 1855.

2105. I. J. Halcome, Cambridge—Skeleton maps.
2107. P. G. Barry, Gray Town, France—Obtaining products from bituminous shale, bog-head mineral, &c.
2109. A. V. Newton, 66, Chancery-lane—Paddle-wheel. (A communication.)
2111. J. Willis, Cheapside—Umbrella and parasol furniture.

Dated 10th September, 1855.

2113. G. A. Biddell, Ipswich—Railway-crossings.
2115. W. R. Lomax, Hammersmith—Steam-engines.
2117. J. H. Linsey, 12, Pilgrim-street, Ludgate-hill—Account and other books.

Dated 20th September, 1855.

2110. J. Page, Perth, and W. Robertson, Dundee—Moulding or shaping metals.

Dated 21st September, 1855.

2121. A. Lees and J. Clegg, Oldham—Looms.
2123. G. S. Parkinson, 14, Devonshire-terrace, Kensington—Railway-breaks.

Dated 22nd September, 1855.

2125. W. Pollitt, Clayton-le-Dale, and J. Eastwood, Blackburn—Apparatus for churning milk and mixing liquids.

Dated 24th September, 1855.

2127. D. Chalmers, Manchester — Cutting pile of woven fabrics.
2120. J. Beattie, 11, Lawn-place, South Laubeth—Furnaces.
2131. H. J. Harcourt, Birmingham—Bell cranks and furniture.
2133. G. R. Hudson, 120, London-wall—Coffee-pot. (A communication.)
2134. J. Musto, Cambridge-road, Mile-end, and F. Bear, 43 Northampton-street, Mile-end—Tobacco machinery.
2135. A. V. Newton, 66, Chancery-lane—Casting solid and hollow articles in metal. (A communication.)

Dated 25th September, 1855.

2137. J. L. Gardner, Providence-street, Walworth—Buttons.
2139. J. C. Clive, Birmingham—Photography.
2141. E. Laport, Paris—Candles.
2143. J. Roberts, Upnor, near Rochester—Cements.

Dated 26th September, 1855.

2145. R. Crankshaw, Blackburn — Preparing warps for weaving.
2147. F. Bouchet, Paris—Moving submerged bodies.
2149. M. W. Hilles, Percy-street, Bedford-square—Rack for window-blinds.

Dated 27th September, 1855.

2151. H. Hughes, Loughborough—Compensating for wear of machinery subject to rectilinear motion.
2153. A. E. Guilbert and C. L. Guillemère, Paris—Bridle.
2155. F. X. Poignaud, Paris—Wedges and keys. (A communication.)
2157. C. F. Théry, London—New preparation of coffee.

Dated 28th September, 1855.

2159. T. Dyke, Long Newton, near Darlington—Grass-cutting machines.
2161. W. D. Gray, 1, Clifton-road, Old Kent-road—Instrument for showing the course or direction and distance run by a ship at sea
2163. R. L. Johnson, Dublin—Gas from peat, &c.
2107. E. D. Thomson, Duke-street, St. James's—Steam boiler-furnaces.

Dated 20th September, 1855.

2169. G. Adamson, Edinburgh—Travelling-crane.
2171. J. Mitchell, Sheffield—Railway-buffers and draw-springs.
2173. D. Chadwick, Salford, and H. Frost, G. Hanson, and J. Chadwick, Manchester—Water and gas meters, and motive-power engine.
2175. J. Beattie, 11, Lawn-place, South Lambeth—Railway wheels and axles.

Dated 1st October, 1855.

2184. W. Kempe, Leeds—Machinery for raising pile on fabrics.
2179. W. Illingworth, Manchester—Printing ceramic manufactures.
2180. C. Radcliffe, Sowerby-bridge—Damping textile fabrics for finishing
2181. A. E. L. Belford, 32, Essex-street, Strand—Ventilating hats. (A communication.)
2183. J. Mitchell, Dunning's-alley, Bishopsgate-street without—Apparatus for washing ores, &c.

2177. J. Gedge, 4, Wellington-street south, Strand—Gas-meters. (A communication.)
2185. J. H. Denning, New York—Projectiles. (A communication)
2187. G. Baker, 149, High-street, and C. Miller, Flying Horse-yard, Southwark—Register stoves.
2189. Capt. F. Uchatius, Vienna—Manufacturing cast steel.
2191. J. R., R., and J. Musgrave, Belfast—Stoves.

Dated 2nd October, 1855.

2192. A. Sands, Manchester—Securing rails in railway chairs.
2193. J. Chadwick, Charlesworth, near Glossop—Carding machinery.
2194. L. M. R. Péan, Paris—Inkstand.
2195. G. Rennie, Holland-street, Blackfriars—Boilers of marine-engines.
2196. R. Threlfall and W. Knowles, Preston—Looms.
2198. J. Bernard, Club-chambers, Regent-street—Boots and shoes.
2199. W. E. Newton, 66, Chancery-lane—Elastic bed-bottoms. (A communication.)
2200. F. F. Benvenuti, Paris—Typography.
2201. G. T. Bousfield, Sussex-place, Loughborough-road—Locks for fire-arms. (A communication.)
2202. G. L. Stott, St. George's, Gloucester—Carbonate of soda.
2203. R. Peyton, Birmingham—Wrought-iron fences and gates.

Dated 3rd October, 1855.

2204. W. Ramscar, Manchester—Fire arms.
2205. T. Greaves, Manchester—Motive-power.
2206. W. Patterson, Batley, and G. Patterson, Sowerby-bridge—Moistening fabrics for finishing.
2207. R. A. Brooman, 166, Fleet-street—Indicating and regulating height of water in boilers. (A communication.)
2208. J. Dickinson, Old Bailey—Paper.
2209. R. Wilkinson, Staley-bridge—Carding machinery.
2210. W. E. Newton, 66, Chancery-lane—Separating metals from their ores. (A communication.)

Dated 4th October, 1855.

2211. R. A. Crosse, Bartholomew's-lane—Founding printers' type.
2212. H. Oldham, Leeds—Weaving textile fabrics.
2213. G. F. Gruet, Bordeaux—Lamps.
2214. J. Lancaster, Deptford—Waterproof material.
2215. H. Cornforth, Birmingham—Hooks and eyes.
2216. T. H. Ryland, Birmingham—Bracelets, &c.
2217. F. G. and T. R. Sanders, Poole—Pottery, earthenware, &c.
2218. C. Hardy, Carstairs, N.B.—Communicating between guards and drivers of railway trains.
2219. W. Hamilton, St. Helen's-lodge, Hants—Tables, chairs, sofas, &c.
2220. E. Meldrum and J. Young, Glasgow—Salts of sodium and potassium.
2221. H. Brierly, Chorley—Self-acting mules for spinning.
2222. H. Over, Cambridge—Gauge knife.
2223. F. M. Demait, Paris—Preservation of animal and vegetable substances.

Dated 5th October, 1855.

2224. P. A. Halkett, Windham Club, St. James's—Motive-power for cultivation of land.
2225. T. Grahame, Lichfield—Floating batteries.
2226. J. D. Pfeiffer, Paris—Knives.
2227. W. Spence, 50, Chancery-lane—Cards for carding cotton, &c. (A communication.)
2228. R. H. Hills, Lewes—Jointed backband for gig or brougham harness.
2229. J. B. Howell, Sheffield—Steel castings.
2230. T. Dickins, Middleton—Silk machinery.
2231. E. C. Wren, Tottenham-court-road—Child's cot.
2232. F. C. Le Page, Paris—Composition as a substitute for wood, leather, bone, metal, &c.

Dated 6th October, 1855.

2233. W. J. Roffe, Upper Holloway—Stoves.
2234. A. Coutinho, Oldham—Motive-power.
2235. B. Hoyle, Pilkington—Dyeing.
2236. J. Washington, Batley, near Dewsbury—Chimney-sweeping apparatus.
2237. J. T. Hester, Oxford—Invalid and children's chairs.
2238. J. H. Johnson, 47, Lincoln's-inn-fields—Consuming smoke of lamps and gas burners. (A communication.)
2239. W. Rogers, New-road, Whitechapel-road—Firo-arms.
2240. H. W. Hart, Birmingham—Cannon for gun-boats.

Dated 8th October, 1855.

2241. J. Denner, 11, Albion-grove-west, Islington—Furnaces.
2242. J. Hubbard, Albion-road, Hammersmith—Sole for boots and shoes.
2243. W. Rothera, Hollins, Lancastor—Bolt, screw, blank, and rivet machinery.
2244. J. H. Johnson, 47, Lincoln's-inn-fields—Transmission and conversion of motive-power. (A communication.)
2245. J. H. Johnson, 47, Lincoln's-inn-fields—Rolling iron. (A communication.)
2246. J. H. Henry, Glasgow—Floating vessels.
2247. W. E. Newton, 66, Chancery-lane—Condonsers. (A communication.)

Dated 0th October, 1855.

2248. R. Willan and D. Mills, Blackburn—Looms. (A communication.)
2240. P. M. Parsons, Duke-street, Adelphi—Joints of pipo and tubes.
2250. J. G. Martien, Newark, U.S.—Iron and steel.
2251. W. C. Jay, Regent-street—Collapsible hat or bonnet. (A communication.)
2253. J. Murdoch, 7, Staple-inn—Extracting colouring matter from lichens. (A communication.)
2254. J. Murdoch, 7, Staple-inn—Extracting colouring matter from lichens. (A communication.)
2255. J. F. Belleville, Paris—Smoke-consuming apparatus.
2256. E. F. Vion, Paris—Tea or coffee pot.
2257. W. H. Lancaster, 24, Hatfield-street, and J. Smith, Sefton-street, Liverpool—Consuming smoke.
2258. S. Goldner, Wimpole-street—Cooking and preserving animal and vegetable matters.

Dated 10th October, 1855.

2260. J. Onions, 44, Wellington-place, Blackfriars—Utilising smoke, heated air, and gases from furnace fires.
2261. J. Gedge, 4, Wellington-street south, Strand—Card drawings used in manufactories. (A communication.)
2262. T., W. A., and G. Fairbairn, Manchester—Casting ordnance.
2263. R. W. Pyne, Southwark, and W. Malam, London-road—Gas.
2264. W. E. Newton, 66, Chancery-lane—Flour-dressing machinery. (A communication.)
2265. J. Parry, Lower Broughton, and S. Ivers, Salford—Looms.
2266. T. Oddie, and W. and J. Lancaster, Preston—Looms.
2267. J. A. W. and H. Thornton, Nottingham—Machinery for knitted fabrics.
2268. D. Hébert, Paris—Heating and arranging ovens. (A communication.)
2269. W. C. Taylor, 11, Devonshire-road, Greenwich—Marine-engines.

Dated 11th October, 1855.

2270. R. R. Reinagle, 12, King William-street, Strand—Barrows, hand-trucks, &c.
2272. J. Gilpin, Leeds—'Raising gig.'
2274. W. Bayley and J. Quarmby, Stalybridge. Carding-machines.
2276. W. B. Adams, 1, Adam-street,' Adelphi—Woodworking machinery
2278. R. A. Tilghman, Philadelphia—Treating fatty and oily substances.

Dated 12th October, 1855.

2280. F. Puls, Soho-square—Electro-coating metals.
2282. T. Moore, Retford—Corn-mill.
2284. C. Ward, 36, Great Titchfield-street—Clarionets.
2286. J. Livingston, Leeds—Permanent way.

Dated 13th October, 1855.

2288. J. S. Cockings and F. Potts, Birmingham—Sockets for whips and candles.
2290. G. A. Thibierge, Versailles—Chlorine.
2292. W. G. Eavestaff, Great Russell-street—Pianofortes.
2294. J. Moseley, Birmingham—Machinery for cleansing linen, &c.
2296. G. T. Bousfield, Sussex-place, Brixton—Power-looms. (A communication.)
2298. G. T. Bousfield, Sussex-place, Brixton—Looms for weaving wire fabrics. (A communication.)

Dated 15th October, 1855.

2300. C. Leftwich, 21, Munster-street, Regent's-park—Water-closets.
2302. T. W. Dodds, Rotherham—Fire-arms, and ordnance, and projectiles.
2304. R. Benton, Birmingham—Motive-power by leverage.
2306. E. A. L. Negretti and J. W. Zambra, Hatton-garden—Mercurial meteorological instruments.

Dated 16th October, 1855.

2308. G. Thompson, Glasgow—Steam-engines.
2310. W. Church, Birmingham—Ordnance.
2312. J. Forrest, Dear's-place, Somers-town—Extracting metals from their ores.
2314. T. A. Claeijs, Bruxelles—Corks and bungs.

Dated 17th October, 1855.

2316. W. Crossley and S. Beaumont, Hulme, Manchester—Cement.
2318. J. H. Clément, Paris—Railway-break.
2322. E. Mackinlay, Glasgow—Reeling apparatus.
2324. W. H. Walton, Glasgow—Carding-machine.
2326. I. J. Halcombe, Cambridge—Gates.
2328. F. Ayckbourn, 30, Palace New-road, Lambeth—Apparatus for brushing and cleaning boots, shoes, and trowsers.
2330. T. Taylor, Manchester—Extinguishing fire.
2332. T. R. Harding, Leeds—Combs, gills, and hackles.

Dated 18th October, 1855.

2334. J. Wakefield, Birmingham—Machinery for screw-blanks, nails, pins, rivets, &c.
2338. J. Graham, Aughton, Lancaster—Cleaning and dressing grain.
2340. J. D. M. Stirling, The Larches, near Birmingham—Coating metals.

Dated 19th October, 1855.

2344. W. Smith, 10, Salisbury-street, Adelphi—Sewing-machines. (A communication.)
2346. J. Elce, Manchester—Self-acting mules.
2348. N. Smith, Thrapston—Mills.

Dated 20th October, 1855.

2350. T. Craven and M. Pickles, York—Weaving.
2352. P. A. H. Parant, Limoges—Millstones.
2354. T. Valentine and D. Foster, and G. Haworth, Belfast—Power-looms.
2356. H. Gaudibert, Paris—Guard for preventing surreptitious removal of watches, &c., from the person.

Dated 22nd October, 1855.

2358. W. Teall, Wakefield—Extracting fatty or oily substances.
2360. A. McGlashan and E. Field, Coal-yard, Drury-lane—Printing presses.

Dated 23rd October, 1855.

2366. A. Gregory, 21, Church-street, and J. Jillings, 6, Temple-street, Whitefriars—Cleansing-pan of water closets.
2638. G. Collier, W. Bailey, and R. Horsfall, Halifax—Drying wool.
2370. T. Roberts and J. Dale, Manchester—Treating amylecious substances for stiffening purposes.
2372. W. Shears, Bankside—Gunpowder magazines.
2374. A. V. Newton, 66, Chancery-lane—Rope machinery. (A communication.)

Dated 24th October, 1855.

2376. J. Bevan, 2, High-street, Deptford—Projectiles.
2378. J. Healey, J. Foster, and J. Lowe, Bolton-le-Moors—Drawing, moulding, forming, and forging machinery.
2380. J. H. Johnson, 47, Lincoln's-inn-fields—Dies and matrices. (A communication.)
2382. E. Butterworth, Rochdale—Spinning machinery.
2384. P. A. le Comte de Fontaine Moreau, 4, South-street, Finsbury—Churns. (A communication.)

Dated 25th October, 1855.

2386. A. Ardouin, 5, Woodland-street, East Greenwich—Corking and capsuling machine.
2388. E. D. Johnson, Wilmington-square—Apparatus for tuning stringed instruments.
2390. J. Robinson, Aldersgate-street—Winding clocks.

Dated 26th October, 1855.

2392. S. B. Sharp and R. Furnival, Manchester—Drilling, grooving, and slotting machinery.
2394. F. C. Calvert, Manchester—Treatment of copper slags to obtain iron.

Dated 27th October, 1855.

2396. Baron de Kleinsorgen, 3, Sidmouth-street—Azimuth compass.
2400. J. D. M. Stirling, Blackgrange, Clackmannan—Cast steel tubes and cylinders.
2402. G. Geyelin, Melville-terrace, Camden-town—Perambulator.
2404. J. Hands, Duke-street, Grosvenor-square—Preserving animal and vegetable substances for food.
2406. I. J. Speed, jun., Detroit, Michigan, U.S.—Car and carriage springs.

Dated 29th October, 1855.

2408. G. Riley, 12, Portland-place north, Clapham-road—Roller mill for grinding malt.
2410. J. Whitworth, Manchester—Artillery and fire arms.
2412. L. Roudière, Paris—Cavalry boots.
2414. W. Heartley, Bury—Safety-valves.

Dated 30th October, 1855.

2418. W. C. Holmes, Huddersfield—Steam boilers.
2420. J. Barrans, Deptford—Steam boiler furnaces.
2422. J. I. B. S. M. de Lignac, Paris—Preserving animal substances.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2271. Jane Ann Herbert, Guilford—Propeller, denominated the "Whinfield or conical propeller." (A communication.)
2345. W. Basford, Penclawdd, Glamorgan—Purification of coal-gas and obtaining a residuum.—19th October, 1855.
2362. P. A. Leroux and L. R. Martin, Paris—Combining a resinous matter with oils or fatty bodies, in order to obtain various useful products therefrom—22nd October, 1855.
2442. A. E. L. Bellford, 32, Essex-street, Strand—Sewing-machines. (A communication.)
2454. J. Lewis and J. Edwards, Dawley, Salop—Malt crushers.
2479. W. H. Walenn, 46, Regent-street—Flattening cylinder glass. (A communication.)

DESIGNS FOR ARTICLES OF UTILITY.

1855.

Oct. 19, 3770. Wheeler, Kinder, and Robinson, Leicester, "Combined expanding carriage bow-spring."
„ 22, 3771. Adolph Stargardter, 4, Mitre-street, Aldgate, "'The kaloped,' or self-adjusting colosh."
„ 22, 3772. Samuel Garside, Ashton-under-Lyne, "Dies of vices for holding tubes or other circular articles."
„ 24, 3773. Fairbanks and Lavender, Walsall, "Stirrup."
„ 25, 3774. Samuel Twist, Birmingham, "Billiard bagatelle-table."
„ 25, 3775. James Fairman, 4, Bishopsgate-street within, "The perflated coat."
„ 31, 3776. William Tasker and Charles Haslem, Newbury, Reading, "A wheel-roller for clod-crushers."
Nov. 6, 3777. James Finlayson, Pendreich, Bridge of Allan, "Finlayson's mechanical plough-guide."
„ 6, 3778. Alexander Hibbs and William Acton, Sheffield, "Horizontal regulating throttle valve."
„ 7, 3779. Charles Burton, 487, Oxford-street, "Portable nursery swing."